A BIOLOGICAL INVENTORY ■■■

■■■■ OF THE LOWER GILA RIVER VALLEY, NEW MEXICO

A Report Jointly Prepared By :

BUREAU OF LAND MANAGEMENT

BUREAU OF RECLAMATION

NEW MEXICO DEPARTMENT OF GAME AND FISH

SOIL CONSERVATION SERVICE

U.S. FISH AND WILDLIFE SERVICE

U.S. FOREST SERVICE

1977

COMPILED AND EDITED

BY

JOHN P. HUBBARD

NEW MEXICO DEPARTMENT OF GAME AND FISH

Table of Contents

INTRODUCTION

Perennial streams in the lowlands of the arid Southwest are infrequent, and those that retain significant natural values are rare. The Gila River in southwestern New Mexico is such a perennial stream, supporting a diverse and well-developed riparian and associate biota in the midst of a xeric region of scrub, grassland, and woodlands. It is the purpose of this report to place on record the flora, habitats, vertebrate fauna, and other natural elements of this valley. Inasmuch as the Gila Valley supports endangered[1] and other significant species and because the riparian biota is becoming ever rarer in the southwestern United States, this reprot is both timely and necessary.

In spite of the biological richness of the Gila Valley, no complete inventory of the flora and fauna has ever been carried out. The present study is based on the literature and on past reports on the area, plus inventories carried out in 1973 by or for the interagency group. This group consists of the New Mexico Department of Game and Fish, Soil Conservation Service, Bureau of Land Management, Bureau of Reclamation, U.S. Forest Service, and U.S. Fish and Wildlife Service. In addition, several individuals were very helpful in providing data, including Dr. Steven Carothers of the Museum of Northern Arizona; Dr. Bruce J. Hayward of Western New Mexico University; Dr. Roy R. Johnson of the National Park Service; and Mr. Paul Turner of New Mexico State University.

The primary purpose of the interagency group and its collaborators was to complete an inventory of various biological resources of the lower Gila Valley, with emphasis on the riparian and aquatic environments. In addition, conclusions on the biota and recommendations for the management of the resource are presented, in keeping with the agreements incorporated in the Memorandum of Understanding (Appendix A). Original data, including the mapped vegetation of the valley, are on file with the Public Affairs Office, U. S. Fish and Wildlife Service, Albuquerque, New Mexico.

Description of area

This lower Gila Valley lies along that portion of the river in southwestern New Mexico between the Gila Wilderness and the Arizona

[1]Endangered species are those that are in danger of extinction throughout all or a significant portion of their range (Federal Government usage) or those whose prospects of survival in New Mexico are in jeopardy or are likely to become so (State of New Mexico usage).

line. This is a stretch of 67 river miles, with the initial elevation 4,700 feet and the final point a thousand feet lower. The terrain traversed varies between plains and low mountains (see Hubbard, 1971), including two reaches of narrow, steep-walled gorges (Map 1). The valley floor varies between 50 to 7000 feet in width, with the average between 500 and 2500 feet.

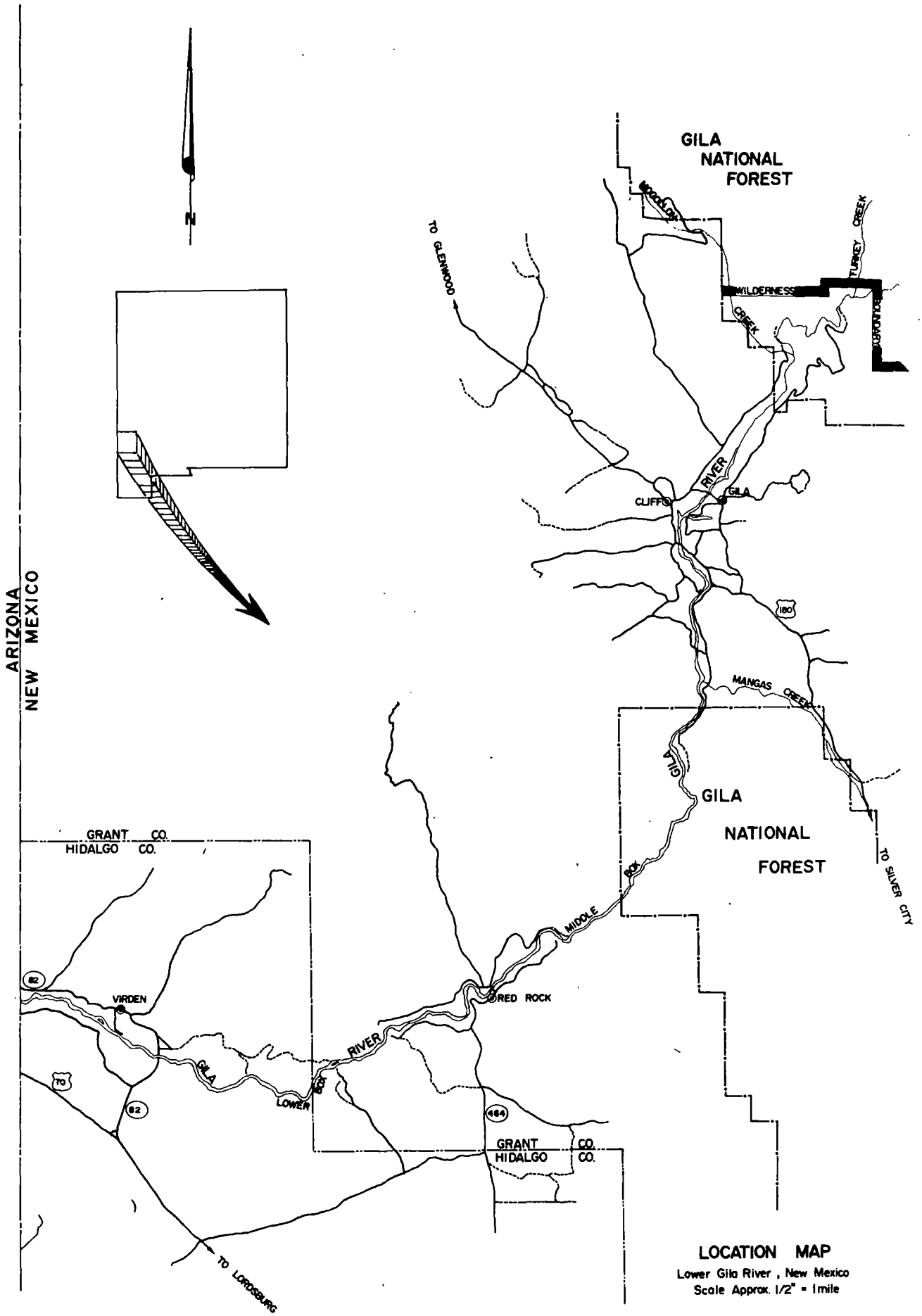
Seventeen river miles are bordered by BLM lands, 19 by Gila National Forest, 30 by private, and less then one mile by State lands. Cattle grazing is widespread in the valley, while surface waters are used for agricultural, industrial, and recreational purposes.

Discussion

Biological study of the Gila Valley began in October 1846, when Emory (1848) made observations and collected specimens there en route between the Rio Grande and San Diego, California. Through the years various biologists visited the area to collect specimens and carry out research, including members of the U.S. Biological Survey in the period 1906-1913 (Bailey, 1928). Various notes and short articles dealing with the fauna and flora appeared through the mid-twentieth century, but the area has only attracted major concern in the last two decades or so.

The first attempt to summarize the biotic resources of the lower Gila Valley appears to have been that of Hubbard (1968), who briefly and in general terms described habitats and highlighted some of the vertebrate fauna (also see Zeller, 1968). Zimmerman (1968) expanded considerably on the bird fauna, particularly as it related to birding and as a reservoir for birdlife (summarized in two appendices). Since then one published (Hubbard, 1971) and several other unpublished reports have appeared on the birdlife and habitats on the Gila Valley, including a study done by Johnson, Carothers, and Wertheimer (1974) for the present inventory.

Aside from birds, no other animal or plant summaries have been published specifically with regard to the lower Gila Valley, although the area has been included in other studies (e.g. Degenhardt and Christiansen, 1974). Obviously, much remains to be learned about the biota of the Gila Valley, although it is clear that this is one of the more diverse and interesting areas in the entire Southwest. Hopefully, this diversity can be preserved in the near future, in spite of the drastic encroachment of man on almost all similar areas in this part of the United States.



LOCATION MAP

Lower Gila River, New Mexico
Scale Approx. 1/2" = 1mile

HYDRIC CHARACTERISTICS OF THE LOWER GILA RIVER

The Gila River of southwestern New Mexico drains an area of 3,203 square miles, between its headwaters and the Virden area at the New Mexico-Arizona State boundary (Table 1). The volume and sediment loads of the stream vary seasonally and from year-to-year, but typically the highest flows follow spring snowmelt and the inception of the late summer rainy season. At Virden, the average discharge in the 48 years of record is 178 cubic feet per second (cfs), with the minimum recorded being 1 cfs (on 14 July 1934) and the maximum 41,700 cfs (on 29 September 1941). Sediment loads are generally low throughout most of the year, with peaks tending to be in August and September (maximum recorded is 26,000 parts per million). Water quality data were taken in October 1973 and are summarized in Appendix B.

New Mexico's water rights in the Gila-San Francisco sub-basins, which are declared underground basins, have been defined and fixed by decree of the U.S. Supreme Court. Present agricultural use of water in these sub-basins has been restricted as to acreage and definite locations, although transfer from agricutural to other uses is permissible and has been substantial. Under the allocations decreed by the Court, a guarantee exists that Arizona users will continue to appropriate the bulk of the water from the Gila sub-basin. In other words, considerably more water will leave New Mexico than the amount that is used in the state.

New Mexico law does not recognize minimum flow requirements for wildlife purposes; hence wild plants and animals have no legal priority for water compared to agricultural and industrial users. While this situation is lamentable, at present there are probably more than adequate minimum stream flows in the lower Gila, as far as sustaining the riparian biota. Nevertheless, there is a definite need for the state to recognize the validity of minimum stream flow requirements for wildlife purposes, as situations have and will continue to develop in which sufficient water will not be available to sustain riparian biotas. To date the biota on the Gila seems not to have suffered any notable decline related to flow levels, but the future may well see problems develop in this area. Management must address these problems, including the question of flooding, which is probably necessary for reproduction in some riparian plants.

Table 1

Summary of Hydric Characteristics

Gauging Station	Gila	Redrock	Virden
Elevation	4658	4090	3875
Drainage Area (sq. mi.)	1864	2829	3203
Years of Operation	48	59	48
First Year of Operation	1927	1905	1928
Discharge (cfs)			
Average	135	198	178
Minimum (year)	14(1971)	2.2(1947)	1(1934)
Maximum (year)	25,400(1941)	40,000(1941)	41,700(1941)
Discharge (acre feet/year)			
Average	97,810	143,500	129,000
Minimum (year)	10,142(1971)	1,594(1947)	724(1934)
Maximum (year)	273,900(1941)	428,400(1941)	409,900(1941)
Diversion Acreage Upstream	500	5,000	6,200

[1]Data primarily from Water Resources. Data for Arizona, Water Year 1975. U.S. Geol. Survey Water Data Report, AZ-75-1.

RIPARIAN VEGETATION OF THE LOWER GILA VALLEY

FLORA

Emory (1846) was apparently the first to collect plants for herbarium specimens in the Gila Valley of New Mexico, and a species that he specifically alluded to was "a new sycamore"--undoubtedly the Arizona sycamore. By the early twentieth century several plant collections had been made in the valley, and Wooten and Standley (1915) listed records of about 50 species from Duck Creek, Cliff-Gila, Redrock, the "Grand Canyon" (probably the box canyon between Cliff and Redrock), the Virden area, and at unspecified localities along the lower valley. Combined with extensive collections made at Mangas Springs and other nearby localities, the known flora of the lower Gila and its immediate tributaries totaled almost 300 species as of 1915.

In recent years much additional plant-collecting has been done in the Gila Valley, but no compendium of the taxa occurring there seems to have been assembled. Presented here (Appendix C) is a preliminary attempt at such a list, based on the literature, herbarium specimens, observations, and other information obtained from such biologists as William Hess, R. Roy Johnson, William Martin, Myra McCormick, and Dale Zimmerman. Although 73 families and over 350 species of plants are listed, this almost

certainly is an incomplete compendium--subject to expansion and improvement.

In view of the absence of more complete data on the flora of the Gila Valley, no attempt is made here to chronicle ecological requirements, phytogeographical considerations, and related types of analysis. The species recorded display an extremely wide variety of ecological requirements, ranging from xerophytes that show no riparian affinity to the mesophytes that would not occur in the area in the absence of a perennial stream. Examples of xerophytes include ephedra, various yuccas, and cacti, while the slate of mesophytes includes cattails, willows, water-cress, and boxelder (see appendix for scientific names). In addition, the existence in the area of such dominant vegetation as seepwillow, cottonwoods, and sycamore is tied to the presence of a high water table, and it is clear that these would not flourish in the valley without the river.

Phytogeographically, the Gila Valley hosts a varied flora, with the dominant component being that representative of the lowland aridlands of southwestern U.S. and adjacent Mexico. Included are lowland as well as higher elevation species, displaying xeric to mesic ecological requirements.

Among the species of special note in the Gila Valley is the Fremong cottonwood, for which this and the nearby San Francisco Valley are the major areas of occupancy in New Mexico. Otherwise this essentially Sonoran species occurs only locally in the southwestern part of the State, being replaced in the Rio Grande and San Juan drainages and eastward by Rio Grande cottonwood (Populus wislizeni). The Gila Valley is also an important area of occupancy for Arizona walnut, netleaf hackberry, western soapberry, velvet ash, Emory oak, and Arizona sycamore, several of which species are at or near distributional limits in the area.

Another interesting aridland component in the flora of the Gila Valley is a typically higher altitude element that includes bluestem willow and Arizona alder, the latter confined in New Mexico to the southwestern part of the State. Riparian species more widespread in North America and occurring in the Gila Valley include boxelder and water-cress. Introduced species include various weedy forbs, plus infrequent trees of black locust, tree-of-heaven, Osage orange, Chinese elm, catalpa, Russian olive, and salt-cedar.

VEGETATION

The riparian vegetation of the lower Gila Valley was mentioned in passing by Emory (1846), who wrote of the riverside fringe of cottonwoods, sycamores, mesquite, and other species of trees and shrubs. Bailey (1913) mapped the Gila Valley as an extension of the Lower Sonoran Zone, which he considers to reach northward to the vicinity of Cliff. In his brief description of vegetation there, Bailey (op. cit:17) referred to the occurrence of creosote-bush, mesquite, acacia, mimosa, chilopsis, fouquieria, zizyphus, sapindus, atriplex, yuccas, and cacti. Referring to the Upper Sonoran aspect of the valley, Bailey (op. cit:29) mentions a "profusion" of wild grapes, currants, wild cherries, hackberries, mulberries, and live oaks, as well as such specific plants as Arizona walnut, boxelder, lanceleaved (= narrowleaf) cottonwood, and alder.

Bailey and other early writers did not place much emphasis on riparian communities, and their descriptions are at best meager and unquantified. The lack of appreciation of the importance of riparian vegetational communities has continued even into fairly recent times; e.g. Castetter (1956), in his extensive review of New Mexico's vegetation, does not even mention them in the State. Castetter's emphasis was on climax vegetation, but by his definition many riparian communities are essentially climax, e.g. "the most mesophytic vegetation that an area will support continuously" (Castetter, 1956:250).

Fortunately, a growing recognition of riparian communities has come about in recent years, and among the first workers to develop this in the Southwest was Charles Lowe. Lowe (1961) defined riparian communities as being those that "occur in or adjacent to drainage ways and/or their floodplains and .... characterized by different species and/or life-forms than that of the immediately surrounding non-riparian climax". Lowe went on to recognize a lowland broadleaf association comprised of Fremont cottonwood, willows, sycamore, ashes, and walnut--with often three or four and occasionally all five types occurring together. He mentions that mesquite, catclaw, and other species form a microphyllous border along the above woodland, while in arroyos such species as hackberry, Mexican elder, and gum bumelia (Bumelia lanuginosa) are riparian components. At higher elevations, Lowe (op. cit.) sketches out another type of riparian woodland, in which Texas mulberry, Arizona alder, narrowleaf cottonwood, boxelder, and other species occur, along with infiltrations of Emory, Arizona, and scrub oaks.

Lowe's (1961) recognition of riparian communities as a significant part of the overall vegetation of the Southwest provided a stimulus for bettering descriptive information and classification of riparian vegetation. In recent years, several studies have focused on these aspects in the lowland Gila Valley of New Mexico, these being mainly Hubbard (1968, 1971) and Zimmerman (1968, 1970). These authors are in general agreement as to what comprises riparian vegetation, but subdivisions and terminology varies among them.

The classification of riparian and associated habitats is somewhat subjective and is perhaps as yet unfinalized. The reason is that riparian habitats display a common feature among biological phenomena: they do not always allow themselves to be neatly pigeonholed! In the case of floodplain vegetation, for example, it is clear that a continuum exists between aquatics on one hand and xerophytes on the other. The continuum is well illustrated by the distribution of tree and shrub species as one progresses perpendicularly away from the river (Table 2).

Table 2

Distribution of Trees and Shrubs in the Lower Gila Valley Floodplain (Solid line indicates common and dashed indicates uncommon occurrence).

Tree and shrub species	Increasing distance from river
Seepwillow	WATERS OF GILA RIVER
Goodding willow	
boxelder	
Fremont cottonwood	
false-indigo	
Arizona sycamore	
velvet ash	
mesquite	
one-seeded juniper	
desert willow	
burrobrush	
Arizona walnut	
western soapberry	
netleaf hackberry	
Emory oak	
gray oak	

The most recent attempt at vegetation classification that has direct application to the Gila Valley is that of Brown and Lowe (1974). Working mainly in Arizona, these authors also extended their classification system to a broader area that includes New Mexico. Using their system, the following vegetation types are recognizable in and along the lower Gila floodplains (specific communities are numbered and underlined):

Forest Formation
  Temperate Forest
    Riparian Deciduous Forest
      1. Mixed Broadleaf Communities
      2. Cottonwood-Willow Communities
Woodland Formation
  Madrean Evergreen Woodland
      3. Encinal (Oak) Communities
  Temperate Woodland
    Rocky Mountain Conifer Woodland
      4. Pinyon-Juniper Communities
    Subtropical Woodland
      5. Mesquite Bosque Communities
Scrubland Formation
  Temperate Scrubland
    Evergreen Sclerophyll Communities
      6. Interior Chaparral
    Riparian Scrub
      7. Seepwillow Communities
Grassland Formation
  Desert Grassland
      8. Beargrass-Scrub Communities
      9. Mixed Grass-Scrub Communities
     10. Shrub-Grass Scrub Disclimax Communities
Desert Formation
  Chihuahuan Desertscrub
     11. Creosotebush-Tarbush Communities
     12. Mesquite Scrub Communities
Marshland Formation
  Temperate Marshland
     13. Bullrush Communities
     14. Cattail Communities

Of the above habitats, those that are of main concern in this study are the Riparian Deciduous Forests (or woodland), comprised of the Mixed Broadleaf and the Cottonwood-Willow Communities. For purposes of fitting field analyses of riparian types to Brown and Lowe (1974), we have combined these communities and, to some degree, the Seepwillow Community (Riparian Scrub). There is considerable

mixing of riparian types in the Gila Valley, and it was decided not to attempt to distinguish them in this final analysis.

HABITAT EVALUATION

Methods

Riparian vegetation was mapped and acreages were computed, using as a base map aerial photographs of the area taken by N.A.S.A. in April 1973. The scale of the photographs is approximately ten inches per mile, and identification of vegetational composition on the base map was made through ground surveys of the area.

In addition to mapping, riparian vegetation was also analyzed to obtain data on composition, density, vigor, stand structure, and ground cover (Appendix D). These data were obtained through a hundred point transect system (modified from the New Mexico Interagency Big Game Browse Range Analysis technique), including occular estimate made by trained observers. Basically, this technique involves a relatively straight-line transect of one hundred paces through stands of habitat that are judged to be relatively homogeneous, i.e. Riparian Deciduous Forests.

The methods for obtaining specific kinds of information are summarized as follows:

Composition - At each of the 100 sample points the nearest living riparian plant within an 180° arc in front of the observer was identified to species. The result was an inventory of 100 plants reflecting the dominant aspect not to exceed four plant species. This information provided the basis for determining stand composition and percent frequency of each species. These data were then subjected to an evaluation to rate composition as follows:

H (high) A and B species (must be 4 or more) making up 75% or more of the composition, with A making up at least 45%.

M (medium) A and B species (must be 3 or more) making up 50% or more of the composition, with A at least 15% of the composition.

L (low) A and B species making up less than 50% of the composition or A less than 15%.

Density - At each of the 100 sample points, the plant selected for tabulation of composition data was classified as a sprout (less than 4½ feet tall), sapling (4½ feet or taller and up to 4.9 inches DBH), pole (4½ feet or taller, 5-8.9 inches DBH) or mature (4½ feet or taller, 9 inches or more DBH).

At each tenth sample point basal area of all visible pole or mature plants was recorded; in addition, crown density of sprouts or saplings was tallied if the crown was wider than the 5 inch angle gauge. The tallies were then totalled and rated as follows:

H 75 or more
M 50-74
L less than 50

Vigor - Data were used from the tabulations of composition (in form of species and frequency) and density (in the form of the representation of age classes on a transect). In addition, all cases were tabulated in which the first riparian plant at sampling points were dead specimens. Finally, browse data, obtained at each data point for plants classed as sprouts, were utilized, with these classified as browsed or not browsed. These three kinds of data were combined, and vigor was classified as H, M, or L (see appendix).

Stand Structure - Data used here were from the tabulations of composition, density, and browse utilization, with categories as follows:

H Less than 25% of A and B sprouts browsed and A and B saplings make up at least 20% of total stand.

M Less than 75% of A and B sprouts browsed and A and B saplings make up at least 10% of the total stand.

L More than 75% of A and B sprouts browsed and A and B saplings make up less than 10% of the total stand.

Ground Cover - At each of the 100 sampling points the ground cover was inventoried, as rock, erosion pavement, bare ground, litter, grass, or forb. The latter two were identified to species and tallied at each sampling point. Categorization was as follows:

H 95 or greater ground cover index
M 80-94 ground cover index
L Less than 80 ground cover index

For the purposes of this study, the following classification of plant species was used:

Riparian	Arizona alder	Fremont cottonwood
	Arizona sycamore	narrowleaf cottonwood
	Arizona walnut	seepwillow (up to 10%)
	boxelder	willows
	desert willow (up to 10%)	
Pseudoriparian		Mexican elder
	Apache plume	mesquite (up to 10%)
	Arizona grape	netleaf hackberry
	California backthorn	seepwillow (if more than 10%)
	desert willow (if more than 10%)	skunkbush sumac
	Emory oak	western soapberry
	gray oak	alligator juniper
	hoptree	
Xeric	allthorn	one-seeded juniper
	catclaw	pinyon
	creosotebush	prickly pear
	graythorn	
	mesquite (if more than 10%)	

RESULTS

MAPPING

Mapping of 67 river miles (Turkey Creek to Virden Valley) of the lower Gila Valley of New Mexico showed a floodplain to exist of approximately 11,892 acres (Table 3). Of this, 5156 acres (43.4%) are irrigated cropland, 4164 (35.0%) are former croplands from which water rights have been transferred, and 2572 (21.6%) are areas of riparian vegetation.

The major areas of croplands are in the Virden Valley (2608 acres), the Cliff-Gila Valley (1472 acres), and around Redrock (876 acres). These areas occupy 96.3, 34.6 and 36.7% of their respective floodplains. These croplands-- all irrigated--are used to grow a variety of crops, the main ones being alfalfa, pasture grass, barley, oats, rye, sorghum, corn, and cotton. In addition, much of the 4164 acres classified as "other land" also has a history of agricultural use, in that it included pastureland and croplands. This category is important, in that it now has the potential of being managed for native riparian habitats.

Table 3

Summary of Floodplain[1] Use and Status in the Lower Gila River Valley, New Mexico (in Acres and as Percentage[2] of Total)

Reach of River	Land Ownership	Extent of Floodplain	Present Land Use in the Valley: Cropland	Riparian Vegetation	Other[3]
1. Turkey Cr.	U.S.F.S.	575 (5%)	--	360(3%)	215(2%)
to Mogollon Cr.	Private	40 (T)	40 (T)	--	--
2. Cliff-Gila Valley	Private	4254 (36%)	1472(12%)	628(5%)	2154(18%)
3. Middle Box	U.S.F.S.	459 (4%)	--	182(2%)	277(2%)[4]
	B.L.M.	49 (T)	--	--	49(T)
4. Red Rock Valley	Private	2389 (20%)	876(7%)	553(5%)	960(8%)
5. Lower Box	B.L.M.	1275 (11%)	--	--	509(4%)
	Private	160 (1%)	160(1%)	748(6%)	--
6. Virden Valley	Private	2790 (23%)	2608(22%)	1(1%)	--
Total		11,892(100%)	5156(43%)	2572(22%)	4164(35%)

[1]Excludes river channel and unvegetated riverwash areas.
[2]T indicates percentage less than 1.
[3]Primarily former cropland from which water rights have been removed.
[4]Indicates U.S.F.S. Gila River Bird Management Area.

The areas of the lower Gila Valley presently occupied by riparian vegetation are concentrated on BLM land in the Lower Box (748 acres) and on private lands in the Cliff-Gila Valley (628 acres) and around Redrock (553 acres). Based on ownership of various stands, the vegetation in the Lower Box--plus that on federal lands in the Middle Box and the Turkey Creek to Mogollon Creek stretch, would seem to have the most secure future. At the present time 1290 of the 2572 acres of riparian vegetation are on federal

Table 4

Changes in Acreages of Riparian Vegetation in the Lower Gila Valley

Location	Acres at Site in the Years: 1935	1954	1965	1973
Gila River at Mogollon Creek	32	45	60	54
Gila River near Mangas Creek	48	26	6	3
Red Rock "Oxbow"	63	68	70	64

land, representing 50.2% of the overall total. These 1290 acres represent 55.1% of the available floodplain on federal lands, indicating that some 44.9% (1050) acres might be available for establishment of additional riparian vegetation.

Mapping also revealed information on the persistence of riparian vegetation, in that aerial photographs taken at intervals of several years provide some indication of decade-to-decade changes at particular sites (Table 4). Examination of the data show that riparian vegetation shifts measurably over time, as stands are eroded away by the river and other factors in some places, only to spread to unoccupied acres in other places. Of the stands shown in Table 4, two showed net increases over a 38 year period, while one showed a net decrease. The latter occurred on the river at junction of Mangas Creek, and the net result was an expansion of the unvegetated river channel at the expense of riparian vegetation.

CONDITION RATINGS

Table 5 summarizes the condition ratings found along the transects that were conducted in 2571 acres of riparian woodland in the lower Gila Valley, New Mexico in 1973. Each of the five conditions rated will be discussed separately. It should be noted that the recorded conditions reflect the effects of severe flooding in autumn 1972 and spring 1973.

Table 5

Summary of Condition Ratings

Condition Factors	High	Medium	Low
Composition	514 (20%)	1263 (49%)	794 (31%)
Density	220 (9)	1425 (55)	926 (36)
Vigor	47 (2)	1090 (42)	1432 (56)
Stand Structure	266 (10)	1074 (42)	1231 (48)
Ground Cover Index	63 (2)	736 (29)	1772 (69)
Total	1110 (9%)	5590 (43%)	6155 (48%)

Composition. The acreages and percentages show that half of the stands were rated medium in species diversity, with the remainder divided between low (the majority) and high. Diversity was greatest at higher elevations, with Fremont cottonwood, Arizona sycamore, netleaf hackberry, Arizona walnut, willows, and boxelder present in significant amounts. In the middle and lower stretches of the valley, cottonwood and Goodding willow are the dominants, with seepwillow and mesquite variably important. Several species aggregations are recognizable in the valley, based on the dominant species (Table 6). These aggregations do not necessarily represent subdivision of riparian woodland, but rather they show the

individual characteristics of stands sampled in this study. Fremont cottonwood is the most frequent dominant, followed by Arizona sycamore, and distantly by all others.

Table 6

Summary of Transect Data by Dominant Plant Species[1]

Arizona sycamore	Arizona walnut	Catclaw acacia	Fremont cottonwood	Goodding willow	Mesquite	Netleaf hackberry	Oaks	Seepwillow	Velvet Ash	Acreage of this type	Percent of Total
			1	2						565	22
			1	2				3		497	20
1			2		4	3				272	11
				2	4	1				181	7
					3	2	1			103	4
								1		107	4
		1						2		91	3
2			1	3						79	3
1	3		2							69	3
	3		1	2				4		69	3
1			2							48	2
3			1	2						43	2
				1		2	4	3		43	2
Other combinations[2]										304	13

[1] numbers refer to place in dominance of a particular stand, i.e. 1(first), 2(second), 3(third), 4(fourth)

[2] includes stands with boxelder, skunkbush, and juniper among the dominants.

Density. Over half the acreage of riparian stands rates medium in this parameter, with a third rating low and a small amount being high. These figures point out the fact that riparian woodland in the Gila Valley tends to be open in nature, with a significant amount rated as being very open.

Vigor. Over half the acreage of riparian stands rates low, with the vast bulk of the remainder being medium. These figures indicate

that many of the trees in riparian stands are old or dead and/or that young trees are severely grazed. Along with the following feature, these ratings of vigor point to a deteriorating state in the remaining riparian woodland of the lower Gila Valley.

Stand Structure. As with vigor, the vast bulk of the acreage rates low and medium in this parameter, with high a small minority. Again, as with vigor, these ratings reflect a dearth of younger trees and an overall deterioration of the riparian woodland of the valley.

Ground Cover Index. This parameter rates overwhelmingly low, with the bulk of the remaining categories being classed as medium. These figures point to a low to non-existent ground cover in the majority of riparian woodland in the valley.

It is clear from the above that the condition rating in the riparian woodland of the lower Gila Valley is not good. A large part of the problem stems from grazing of livestock in these stands, for such species as cottonwoods are highly palatable to cattle and horses. Compounding the problem are floods, lowered water table, clearing and other disturbance, and perhaps some biological difficulties. Among the latter is the low level of reproduction in Arizona sycamores from sources other than sprouts.

Unless steps are taken to reverse the factors that are causing deterioration of riparian woodland in the lower Gila Valley, it is assured that condition ratings will continue to decline. There are already scarcely any stands that can be considered primeval-like in the valley, and as older trees die off without replacement, the overall acreage of woodland will further shrink. It is difficult to believe that the riparian fauna dependent on the woodland can flourish much longer if condition ratings and acreages degrade much further.

DISCUSSION

There can be no doubt that a river valley, such as that of the lower Gila River, is both a boon and a bane to the existence of many plants and communities. The boon is in the form of a constant, bountiful water supply; the bane is in the form of fluctuations in the supply, which periodically may be too little and too much. This boon-or-bane situation has no doubt elicited responses in the plants of the floodplain; however, the benefits must far overweigh the detriments--judging from the diversity and luxuriance of the habitats that occupy the valley.

The diversity in habitats is not limited to the floodplain, as the valley slopes and adjacent plains and hills support a varied spectrum of vegetation from grassland to evergreen woodland. These are important adjuncts to riparian habitats, and together they sustain a very diverse biota. In many ways riparian and non-riparian biotas are inseparable, as a continuum exists not only among plants, but in animals as well. However, for purposes of this report, the focus is on the floodplain and the plants and animals that it supports.

Stream systems, especially in areas of varied topography, serve more purposes than just transporting water from one point to another. In a region such as New Mexico, they also provide a major outlet for disposal of the by-products of natural erosion. If nature abhors a vacuum, it also abhors topographical prominence, and many forces operate to reduce mountains to plateaus and then to plains. This reduction takes place grain-by-grain, and a vast number of grains find their way into the world's rivers and seas each year.

The presence of the by-products of mountain reduction, as well as differing levels and pathways of water, are among the hazards that floodplain species must survive if they are to persist. Different species respond in different ways to these challenges, but few are as successful as cottonwoods. True, floods do take a toll of these trees every few years, but high waters also prepare the beds for the millions of seeds produced every year. Siltation can be a problem, too, when it covers trees in deep layers; however, cottonwoods sprout readily from fallen fragments, and silt enriches the soil for their new growth. Willows, seepwillows, sycamores, and other species also show a resilience to the "bane" aspects of riparian life, and they respond to the challenges of the river with a vigor that approaches that of cottonwoods.

As is typically the case, the presence of man in a situation such as this river-versus-plant confrontation leads to problems. The effects of land clearing for various purposes, vehicle traffic, water diversions, lowered water tables, dams, livestock grazing, pollution, and other factors pose a new set of challenges that riparian vegetation must meet to survive. No doubt, in some cases the added load is too much, and individuals and stands perish.

We have seen that at present the floodplain of the Gila Valley supports riparian vegetation on only 21.6% of its total acreage. The effects of grazing and other factors have seriously affected reproduction, and many stands of riparian woodland are rapidly aging with little replacement in prospect. So far the quality of

water does not seem to be a detriment, and for some reason(s) the Gila has been spared the massive invasion of such exotics as salt-cedar and Russian olive. However, without doubt there is a steady decline in the quantity and quality of riparian habitats in the Gila Valley, and the factors leading to this must be addressed and reversed if this extraordinary biota is to persist.

INVENTORY OF MAMMALS

Introduction

The riparian and associated habitats of the lower Gila Valley support a diverse mammalian fauna, ranging from mesophilic to xerophilic species. Several biotic regions contribute species to the fauna, and several species reach their distributional limits in or near the study area. Finally, there are species considered as endangered in New Mexico in the Gila Valley.

Methods

No thorough review of the mammals of the Lower Gila per se has been published, but the fauna has been touched on by several workers. In their compendia of New Mexico mammals, both Bailey (1931) and Findley et al. (1975) mention occurrences of various species on the Gila or in the near vicinity. Various other authors have published details of the occurrences of one or more species in the area, but even these reports are few. In addition, Dr. Bruce Hayward has carried out mammals studies in the areas since 1961, and he has kindly provided us with a list of species that he has recorded there. With regard to the present study, no specific work was done on mammals, and it is clear that much more work is needed there.

Discussion

Bailey (1931), Hayward (ms.), and Findley et al (1975) have recorded 67 species of mammals in or near the lower Gila Valley, a total representing about half of the New Mexican fauna (Appendix E). In addition, other possibly-occurring species are other bats. eastern cottontail (*Sylvilagus floridanus*), pinyon mouse (*Peromyscus truei*), long-tailed weasel (*Mustela frenata*), and others. Finally, several locally-extirpated species may have ranged into the vicinity, including the grizzly bear and jaguar (*Felis onca*); besides these, other now-extirpated species are known to have occurred in the valley, i.e. the black-tailed prairie dog and the gray wolf.

The breakdown of the species now thought to occur in the lower Gila Valley includes one shrew, 15 bats, two rabbits, six squirrels and allies, one pocket gopher, seven pocket mice and kangaroo rats, beaver, 12 native mice and rats, the house mouse, porcupine, 15 carnivores, and five ungulates (Appendix E).

About one quarter of the mammal species of the lower Gila Valley are at or near distributional limits there; of these, about half are at southern and half at northern limits. Examples of the latter include small-footed myotis, valley pocket gopher, beaver, muskrat, and porcupine, while the Arizona gray squirrel, several pocket mice, cactus mouse, hooded skunk, and javelina are at or near northern limits.

Several game and furbearing species occur in the lower Gila Valley, chief among which are raccoons, beavers, and mule deer. Beavers offer a particular problem, in that in some areas they are destructive to riparian habitats. However, where controls by man or nature exist, this destruction can be checked and held within natural limits. Deer numbers are generally low, and it is possibly that excessive competition from livestock may inhibit their numbers.

Mammals that are primarily restricted to riparian environments are few, consisting of such species as the Arizona gray squirrel, beaver, muskrat, and raccoon. Although the Gila mammal fauna contain few riparian-restricted species, the valley undoubtedly does act as a conduit for dispersal of many species through the plains and mountain country of southwestern New Mexico. Several of these species are listed in the above paragraphs, but some can be mentioned again here. For example, the Arizona gray squirrel enters New Mexico along the Gila and its tributaries, including the San Francisco River, occurring northward to Apache Creek (Raught, 1967) and the Gila Cliff Dwellings (Hayward and Hunt, 1972) and as high as (7000 feet plus) Mogollon and its vicinity. This squirrel is of interest because of its limited distribution, which includes adjacent Arizona--the major range of the species--and northernmost Sonora. This is a species essentially endemic to the Southwest, and the Gila drainage is perhaps its center of distribution.

Another species of interest, but one of perhaps only casual or former occurrence, is the river otter of the Arizona race, Lontra canadensis sonora. Bailey (1931) mentions hearsay records from the Gila from the last and early twentieth centuries, but it was not until October 1953 that specimen substantiation was obtained of the occurrence of this species in the lower Gila Valley

(McClellan, 1954). Even so, the species must be extremely rare in the area. Berghofer (1967) also mentions that mink (Mustela vison) were common in the Gila drainage, but no substantiation seems to have been reported from there.

Other species that seem to use the Gila Valley as a distributional corridor are the cactus mouse and hooded skunk, as well as the riparian-dependent beaver and muskrat. Thus, the Gila Valley is not only important in providing habitats for mammals, but it also enriches the fauna of southwestern New Mexico by aiding the dispersal of species into the area. Among the species involved are various restricted, rare, and peripheral mammals, the presence of which makes the Gila Valley even more important as a reservoir for wildlife.

INVENTORY OF BIRDS

Introduction

The riparian and associated habitats of the Gila Valley in southwestern New Mexico support a diverse avifauna, drawing species from several distinct biotic areas. While the valley actually communicates with Sonoran Desert, it traverses part of the Chihuahuan Desert as well as highland areas that support Rocky Mountain and Sierra Madrean biotic elements. These source areas for species combine to make the breeding riparian avifauna of the Gila Valley the richest of any in the lower Colorado drainage (Johnson et al., 1974) and probably of any in the Southwest. In addition, breeding densities of riparian birds appear to be comparable to those of the Verde Valley of Arizona, which are among the highest for any area in temperate North America (Johnson et al., op. cit.).

The Gila Valley also represents a highly significant breeding area for raptors (Johnson et al., op. cit.) and for peripheral species (Hubbard, 1971), and its diversity of species makes it very important for bird watchers, naturalists, and scientists (Zimmerman, 1968, 1970). Several species on the federal endangered list are known from the valley, including the Mexican duck, bald eagle, and peregrine falcon (Zimmerman, 1970).

Methods

The first recorded data on birds in the Gila Valley were obtained in 1846, but significant contributions began there in the

1870's. Hubbard (1971) summarized the summer birdlife of the lower valley from the earliest exploration through 1970, describes the region and its habitats, and analyzed the avifauna over that period. Zimmerman (1970) carried out a study in 1969 of the birdlife and habitats on those parts of the valley lying on the Gila National Forest, and he made recommendations on their conservation. Hayward and Hunt (1972) did survey work in 1972 that included birds in the northern segment of the lower valley, namely in the Turkey Creek area. Ohmart (1973) included the Hooker Dam site in an avifaunal comparison including three other dam sites in Arizona. Finally, in 1973, as part of the present inventory, Johnson, Carothers, and Wertheimer (1974) collected additional data from the lower valley and made comparisons with other river systems. Zimmerman (op. cit.) and Johnson et al. (1974) also carried out some preliminary census work on breeding birds.

Discussion

Hubbard (1971) listed 143 species of birds as recorded in the lower Gila Valley in summer (June-first half of July) in the period from 1876 through 1970, not counting the wild turkey reported in 1846. Of these species, 112 were thought to have bred in the area, while 31 were considered as migrants, vagrants, or status undetermined. Of the breeding species, 70 (62.5%) were regarded as more or less regular, 25 (22.3%) as more or less irregular, and 17 (16.2%) as casual to occasional in occurrence. Zimmerman (1970) listed 86 species as probably breeding on riparian and associated habitats on or within a few miles of Forest lands in 1969, plus five migrant or wandering species. These summer species included none not already reported from the valley by Hubbard (1971), but Zimmerman apparently considered three species (i.e. sharp-shinned hawk, violet-green swallow, and solitary vireo) as breeders which Hubbard did not. Zimmerman also included a list of 164 nonbreeding species known from in or near Gila National Forest lands in the valley. Johnson et al. (1974) found about 80 breeding species in riparian habitats along the lower valley in the summer of 1973, including the not-previously-recorded-breeding prairie falcon. These workers emphasized birds of riparian habitats, and they eliminated species of other habitat types as well as those of casual occurrence or uncertain status. A point of particular interest made in Johnson et al.'s (1974) study is the fact that the lower Gila Valley appears to support "the most diverse avifauna of any river in the lower Colorado River drainage".

Approximately 80 breeding species were ascribed by these workers to the riparian habitats of the lower Gila, over a distance

of 55 river miles with an elevational drop of only 1000 feet. Similar rivers in Arizona support 61 to 77 species, often over a greater extent of river miles and with greater elevational drops.

Based on the aggregate lists of the various workers in the lower Gila Valley, at least 144 species have been recorded in summer, of which 116 are suspected of having bred. In addition, 110 other species have been recorded there outside the summer, to bring the total recorded to 265 species (Appendix F).

The utilization of habitats by the avifauna was reviewed by Hubbard (1971), who found that 55 (49.1%) of 112 breeding species were primarily riparian and would probably not occur in the study area in the absence of such habitats. The remaining 57 (50.9%) of the species were apparently independent of riparian habitats, but 25 (22.3%) of these made some to extnesive use of such areas. Zimmerman (1970) also listed certain species of breeding birds as typical of riparian or other habitats, but he did not do a quantified analysis of these. In their study, Johnson et al. (1974) listed 32 of 80 (40.0%) breeding species as obligates of riparian habitats, versus 45 (56.2%) that were facultative users of such habitats and three (3.8%) that were nonriparian. The lack of better agreement between these figures and those of Hubbard (1971), which show a higher incidence of obligate riparian species, is due to the fact that Johnson et al. define the degree of "riparian-ness" on the basis of species' behavior in Arizona as well as the study area.

Densities among breeding birds in 1969 were measured by Zimmerman (1970) as 708 adults (48 species) per 100 acres at one site and 826 per 100 at another. The respective census tracts consisted of a half-mile strip of cottonwoods and willows and a 14-acre mature cottonwood stand. Unfortunately, these data cannot be easily compared with densities form similar habitats in Arizona's Verde Valley, because the data from the latter area (e.g. Johnson et al., 1974) are given as <u>pairs</u> rather than <u>adults</u> per 100 acres. However, it would appear that the values from the Gila Valley would approach those from the Verde Valley, which varied from 512.1 to 847.2 pairs (20 to 26 species) per 100 acres. Johnson et al. (op. cit.) did not census cottonwood-willow habitats in the Gila Valley, but their general estimates suggested that densities there were similar to those in these habitats on the Verde. Johnson et al. (op. cit.) did make some comparisons in mixed deciduous habitats in the two areas, and densities in the Gila Valley were similar to those in the Verde Valley.

From a biogeographic view, the breeding avifauna of the Gila Valley is quite varied. Hubbard (1971) found that 79 (72.5%) of the 109 native species were North American, 22 (20.2%) ranged to South America, and eight (7.3%) were more cosmopolitan. More important are the several species that are at or near northern limits in the Gila Valley (e.g. black hawk, white-winged dove, elf owl, lesser nighthawk, Wied's crested flycatcher, bronzed cowbird, hooded oriole, cardinal) and others that are at southern limits there (e.g. mallard, spotted sandpiper, willow flycatcher, common crow, indigo bunting). Several other interesting species occur in the area, among which are such Sonoran species as Gila woodpecker, Lucy's warbler, and Abert's towhee, and Sierra Madrean or Mexican Plateau species as Mexican duck, Montezuma (harlequin) quail, Mexican jay, and bridled titmouse. The Abert's towhee occurs nowhere else in New Mexico.

It has been emphasized that the breeding avifauna of the Gila Valley is rich in raptors, in fact exceeding any other river system in the lower Colorado drainage (Johnson et al., 1974). A total of nine species of hawks and falcons, plus four of owls brings the total to 13 breeding there, counting the gray hawk.

In addition, the Mexican duck, bald eagle, and peregrine falcon are known to occur in the Gila Valley, species in which at least some races are listed as endangered by the U.S. Fish and Wildlife Service. The olivaceous cormorant, gray hawk, zone-tailed, black hawk, osprey, Gila woodpecker, and Bell's vireo are species listed as endangered in the State by the New Mexico Department of Game and Fish.

In summary, the avifauna of the lower Gila Valley is extremely rich, numbering at least 265 species. Of these, at least 116 are suspected to have bred there. About half the breeding species are dependent on riparian habitats and many others make use of them. Clearly the valley is a very significant and important area of occupancy for birdlife, including various endangered and peripheral as well as riparian species.

INVENTORY OF AMPHIBIANS AND REPTILES

Introduction

The riparian and associated habitats of the lower Gila Valley support a diverse herpetofauna, ranging from mesophilic to xerophilic species. Both amphibians and reptiles are well represented in the valley, and these are representative of several biotic regions and

a varied array of ecological and behavioral types. Among the most important features about the fauna is the fact that several species reach distributional limits in or near the study area, especially from the Sonoran Desert herpetofauna. In addition, several species are listed as endangered in New Mexico.

Methods

No thorough review has ever been published on the amphibians and reptiles of the lower Gila Valley , although many people have done herpetological work there. Significant collections of these groups of animals may exist in the U.S., but no attempt to survey these has yet been made. The data presented here represent a review of the literature and a summary of observations by various field workers, including those who conducted other types of surveys during the present study. Of particular help has been a list of species prepared by Dr. Bruce J. Hayward, based on his 14 years of work in the area.

Discussion

The total species recorded in the lower Gila Valley consist of 11 amphibians and 40 reptiles (Appendix G), and at least one other amphibian and 14 reptile species are to be expected in the area. Of those species actually recorded in the Valley, at least 31 have been collected or photographed, while the remainder are only known from sight reports.

The breakdown of species consists of one salamander, 10 toads and frogs, two turtles, 18 lizards, and 20 snakes. The amphibians consist of the widespread tiger salamander, three species of spadefoot toad, four true toads, treefrog, and two true frogs--of which the bullfrog is introduced. Two turtle species have been verified in the area, and possibly the box turtle (Terrepene ornata) occurs in the valley, although Degenhardt and Christiansen (1974) show no records there. The lizards are primarily in the iguana family, although the three teids and single species of three additional families are also represented. Snakes fall into 15 harmless or rearfanged species, a blind snake and five poisonous species.

As an indication of the diversity of the herpetofauna of the Gila Valley, about two-thirds of the amphibians and half of the reptile species recorded in New Mexico are known from the area. Many species are at or near distributional limits, including about 36 percent of the amphibian and 55 percent of the reptiles. The

reptiles. The largest category in each case consists of species at or near their northern limits in the valley, with 27 and 50 percent of the species in the respective groups. Among the more notable species are the following southern forms at or near their northern (or northeastern) distributional limits: Sonoran mud turtle, banded gecko, Gila monster, Sonoran whipsnake, Mexican garter snake, and Arizona coral snake.

Ecologically, many of the amphibian species use the riparian habitats of the lower Gila Valley; however, only the tiger salamander, western spadefoot toad, southwestern toad, canyon treefrog, and the two true frogs appear closely dependent of mesic environments in the area. These species comprise about half of the amphibian fauna, the other species being more xeric-adapted.

Among the reptiles, the more mesic-adapted species include the two turtles, alligator lizard, Sonora mountain kingsnake, black-necked and Mexican garter snakes, and perhaps the coral snake, which comprises about 17 percent of the fauna. In this regard reptiles seem to show the least dependence of any vertebrates on the riparian environments of the valley, although this has not been studied in detail.

Species occurring in the area and listed as endangered in New Mexico are the Gila monster, Sonora mountain kingsnake, and Arizona coral snake. The Mexican garter snake is also rare in New Mexico and may well be endangered there.

INVENTORY OF FISHES

Introduction

While not rich in species compared to more mesic parts of North America, the lower Gila River does retain a large portion of its native ichthyofauna. This ichthyofauna is derived from the Colorado Basin, which Dunbier (1968) singles out as being one of the most tightly controlled and highly developed river systems in North America. As a consequence, this system has highly distinctive native fish fauna, with most of the species being endemic. In spite of introductions and habitat alteration, the lower Gila River is a major refugium for this fauna; however several species are considered endangered in New Mexico.

Methods

This compendium is based on a study of the literature and other data, including an interagency survey made in July and October 1973. For the survey eleven stations were used, starting at Turkey Creek and progressing downstream. Most sampling was done by electrofishing, using a 110 volt Mite-E-Lite generator. Electrodes were moved upstream for 600 to 800 feet at each station, with downstream shocking into bag seines used on deeper ponds. Creel checks, gill nets, dip nets, seines, angling, and cherry bombs were also used to sample fish, and attempts were made to sample all habitat types, e.g. deep pools (quiet and running), shallow isolated pools, riffles, sand and gravel bottom areas, undercut banks, and areas around tree stumps. The river flows during sampling were 70 to 80 cfs.

Discussion

The first published ichthyological record from the lower Gila River in New Mexico is that of Emory (1848), who reported an abundance of Gila "trout" in the river in October 1846. From the drawing in that account it appears that the species in question was the roundtail chub. Koster (1957) summarized the fishes of New Mexico and listed seven native species as occurring in the lower Gila. LaBounty and Minckley (1972) listed six native fishes, with the roundtail chub missing. Our interagency surveys showed that the chub still persists in the Gila, so that all seven species present as of 1957 were still there in 1973.

The native species (Appendix H) known from the lower Gila include two in endemic, monotypic genera, i.e. the loach minnow and the spike dace (endemic means confined to the Gila drainage in our usage). Endemic species are represented by the Gila sucker, while the roundtail chub is an endemic subspecies (G.r. grahami). The longfin dace and the Gila mountain sucker occur in areas outside the Gila, but they may have originated in the latter drainage. The remaining native species, the speckled dace, is widespread in the Pacific drainage of the United States. Of these species, the loach minnow, spike dace, and roundtail chub are listed as endangered in New Mexico.

Several other native fishes may have occurred in the lower Gila River in historic times, but definite records are lacking. These include the Colorado River squawfish (Ptychocheilus lucius), razorback sucker (Xyrauchen texanus), and flannelmouth sucker (C. latipinnis). In addition, the Gila topminnow (Poeciliopsis occidentalis) formerly occurred in the San Francisco River and may

also have been present in the Gila. The Gila trout (Salmo gilae) occurs in headeaters of the Gila drainage. All of these species, except the flannelmouth sucker, are federally-listed endangered species.

Introduced species (Appendix H) in the lower Gila River have increased through the years, although at present only rainbow trout and channel catfish are being released there. LaBounty and Minckley (1972) show six introduced species in the lower Gila in 1940 and 15 of varying species in 1950, 1960, and 1970. The introduced species total 19, of which 12 are game fish and the remainder are bait fish or unclassified. In surveys in 1973, only 11 introduced species were found, all previously recorded in the river.

The introduction of exotic species into the Gila River poses a problem of varying degrees to the native ichthyofauna, ranging from competition to predation. In this regard it is interesting to note that 74% of the specimens collected in the 1973 survey are of native species. The proportions of specimens of various native to exotic species at different localities varied in the survey. For example, in July 1973 the proportion varied from 20 to 100% native species, with the average being 65% for 11 collecting sites.

In spite of the fact that native species comprise the bulk of the specimens, some indigenous fishes appear to have declined in numbers as exotics have increased in the river. For example, the roundtail chub is much less common now (LaBounty and Minckley, 1972), perhaps due to competition with and/or predation by smallmouth bass. Introduction of exotics--both game and bait species--continue at the present time, and it is almost a certainty that this is to the continuing detriment of the native species.

The ichthyofauna of the entire Gila drainage (New Mexico and Arizona) consists of 16 species, of which 11 are mentioned above. The other species in this fauna are the bonytail chub (Gila elegans), intermediate chub (G. intermedia), woundfin (Plagopterus argentissima), desert pupfish (Cyprinodon macularius), and the Apache trout (Salmo apache). At one time all of these except the last occurred on the Salt River at Tempe, Arizona, but by 1940 only three species persisted and only two suckers were found by 1972 (LaBounty and Minckley, 1972). This degree of decline is also prevalent in many other parts of the Gila drainage, and in this regard the lower Gila River of New Mexico is a notable exception.

SUMMARY DISCUSSION

The data that have been presented here for the lower Gila Valley, Grant and Hidalgo counties, New Mexico, clearly outline the biological importance of the area. This importance centers on such aspects as the floristic and faunistic richness, biogeographic and ecological considerations, and the fact that the valley provides a significant refugium for lowland riparian habitats. These habitats are the crux of the importance of the Gila Valley, because in large part the other biological values revolve around them.

The major riparian habitats of the lower Gila Valley are woodlands comprised of several species of broadleaf, mainly winter-deciduous trees. The most important of these are Fremont cottonwood, Goodding willow, Arizona sycamore, Arizona walnut, netleaf hackberry, and boxelder. Laterally on the floodplain other species are found, while yet others occur as one ascends the river. The aggregations of broadleaf trees constitute one of the most diverse arrays in the U.S., west of the great deciduous forests of the East. Together with riparian shrublands--comprised largely of seepwillow thickets--they dominated the primeval floodplain of the Gila Valley.

The overall extent of riparian woodland and shrubland communities has not been large in recent millenia in the Southwest, because suitable floodplain areas are very limited in that arid region. Much of the suitable areas are no longer occupied by these riparian habitats, because European settlement has led to their being taken over for other purposes, e.g. agriculture, dams, settlements, and so on. Even where riparian habitats have not been directly eliminated, factors such as reduced water availability, grazing and erosion have decimated them and/or prevented their reproduction.

While the native vegetation of the Gila Valley has decreased from its probable primeval dimensions, about 20% of the floodplain (or 2572 acres) is presently occupied by riparian habitat. The major areas lost have been in the agricultural regions around Cliff, Redrock, and Virden, all lying in the broadest parts of the valley. Elsewhere riparian habitats remain variably widespread although reduced in size and with stands subject to mistreatment and some now definitely declining. Federal lands support some 1290 acres or 50% of riparian habitats and would support more with improved management of livestock.

In spite of losses incurred in the extent and quality of riparian habitats in historical time, the plant and animal life in the Gila Valley is extremely diverse and abundant. Over 350 species of plants are known from the vicinity, along with 67 species of mammals, 265 birds (116 species have bred in the valley), 11 amphibians, 40 reptiles, 7 native fishes, and innumerable invertebrates. Many of these species are in some way unusual, e.g. many plant and animal species reach a distributional limit in the area. The valley contains New Mexico's major parcel of Fremont cottonwood-Goodding willow woodland, and its waters are a major stronghold for Colorado Basin fishes, including several endemic taxa. Attrition in species diversity seems to have been limited to data among such groups as vertebrates, but as habitat declines continue the animal life will be affected. Certainly, the numbers and overall biomass of riparian plants and animals have declined as the available areas of occupancy have diminished.

Management directions for halting and reversing the decline of the riparian biota of the lower Gila Valley are varied and many. Aside from the need for man to curtail taking over of more floodplain areas, serious considerations need to be given to restoring parts of the valley to native habitats and to allow those that remain to prosper and expand. The data presented here clearly show that the general condition of riparian woodlands is not good, especially as regards to reproduction and related features. This problem is largely attributable to livestock impacts, although flooding and other factors are also implicated.

This inventory of the flora and fauna of the lower Gila Valley of New Mexico points to the biological importance of the area, and the general assessment of status of the elements points to a need for concerted actions to maintain this importance. Having documented the nature of the resource, it behooves us to take the necessary steps to preserve and maintain it. In this regard, a series of findings is proffered, in hopes that they may guide us in our attempts to coexist with this significant and important biotic area:

1. The diverse riparian biota of the lower Gila Valley is a significant natural resource of the State of New Mexico and the Nation.

2. The area occupied by this biota has shrunk extensively in historic times, and at present only about 20% of the flood plain of the valley is occupied by natural habitats.

3. Indications are that the riparian biota of the lower Gila Valley will suffer continued attrition, as a result of the activities of man and his livestock.

4. No comprehensive management of the area has been undertaken, and only haphazard efforts have been extended toward better understanding, maintaining, and restoring the riparian biota of the lower Gila Valley.

5. Recommendations are needed if this biota is to survive and prosper, and only a coordinated and comprehensive management plan holds promise of a long-term future for this highly significant biotic area.

RECOMMENDATIONS

1. Existing riparian habitat must be maintained and, to whatever extent possible, restored to former areas of occupancy.

    1. Public Lands - usage policy must be reviewed and revised to obtain the above objective by:

        a. Controlling of grazing to allow vegetation to reproduce and mature.
        b. Controlling of motorized access to prevent damage to vegetation and substrate.
        c. Banning of clearing, cutting, fires, and other damaging activities in such areas.
        d. Limiting reclamation activities that impinge on such stands and their habitats.
        e. Maintaining sufficient ground water and stream flows to sustain vegetation and aquatic habitats.
        f. Improving watershed conditions as benefit riparian vegetation.
        g. Limiting all developments that are detrimental to riparian vegetation and its habitat.
        h. Planting riparian species in areas of historic occurrence.
        i. Controlling depredations by beavers and other organisms that may have a gross negative effect on stands.
        j. Continuing studies of riparian vegetation in regards to typing, condition, requirements, and associated factors.
        k. Setting aside preserves, such as the Gila River Bird Management area of the Gila National Forest.
        l. Educating the public as to the values of riparian vegetation.

2. Private Lands - Where possible these should be procured as public domain through purchase or easement; where such procurement is not possible, landowners should be approached with the aim at management of their lands to maintain or foster the riparian biota.

II. Riparian faunal elements should be managed for in ways above and beyond those aspects that proper management of riparian habitats will provide, by:

a. Controlling of harassment, killing, capturing, or otherwise interfering with such species, except where an agency determines that such activities are warranted through the pursuit of game, fish, and other sanctioned activities.

b. Controlling of domestic animals, which may compete with, prey on, or otherwise negatively impact on native species.

c. Controlling of the introduction of exotic fauna that may compete with, prey on, or otherwise negatively impact on native species or that may change the character of the biota.

d. Restoring feeding, breeding, resting, and other sites for such species.

e. Continuing studies of the distribution, status, numbers, requirements, and associated factors of the riparian fauna.

f. Educating the public as to the values of the riparian fauna.

III. Wildlife and wildlife habitat considerations should be made an integral part of all management activities in the lower Gila Valley and vicinity, by:

a. Embarking on an overall multiple use management plan of the area, with all relevant agencies involved from outset to finish.

b. Coordinating all activities involving development on the river so that wildlife needs are met at the outset rather than after the fact.

c. Zoning the valley for various kinds of activities that can be carried out, with the goal of placing wildlife needs as an equal in any multiple use approach for the riparian system.

d. Subjecting all developmental activities to close scrutiny and study as relate to wildlife needs--with mitigation to be a standard and guaranteed requirement where impacts are negative.

IV. The longterm goals should involve a commitment by man to respect the rights of the native biota to continue to occupy and prosper in the Gila Valley and for mankind to place himself and his use of the valley in a proper perspective in regard to the proper functioning of nature.

ACKNOWLEDGEMENTS

This study would not have been possible without the help and cooperation of many people and organizations; among the latter are the Bureau of Land Management, Bureau of Reclamation, New Mexico Department of Game and Fish, Soil Conservation Service, U.S. Fish and Wildlife Service, and U.S. Forest Service. We thank Dr. Bruce J. Hayward for suppling data on vertebrates and for reading a draft of the manuscript and Dr. Roger Peterson for providing information on botanical nomenclature. Private landowners and the Phelps-Dodge Company allowed access to their lands, for which we are grateful.

Bibliography

Bailey, F. M. 1928. Birds of New Mexico. New Mexico Dept. of Game and Fish, Santa Fe.

Bailey, V. 1931. Mammals of New Mexico. North Amer. Fauna 53.

Berghofer, C. 1967. Protected furbearers in New Mexico Wildlife Management, N.M. Department of Game and Fish, Santa Fe.

Degenhardt, W. G. and J. L. Christiansen. 1974. Distribution and habitats of turtles in New Mexico. Southwest Nat. 19:21-46.

Emory, W. H. 1848, Notes on a military reconnaissance from Fort Leavenworth, in Missouri, to San Diego, in California, including part of the Arkansas, Del Norte, and Gila rivers. 30th Congress, First Sess., Dec. 41 Washington, Wendell and van Benthuysen.

Hayward, B. J. and D. L. Hunt, Jr. 1972. Vertebrate survey of the Wilderness Ranger District, Gila National Forest, New Mexico. Mimeographed ms., 58 pp.

Hubbard, J. P. 1968. Biological resources of the Gila River in New Mexico, considerations raised by the Hooker Dam proposal. Mimeographed ms., prepared for Sierra Club; 4 pp.

Hubbard, J. P. 1971. The summer birds of the Gila Valley, New Mexico. Nemouria 2.

Johnson, R. R., S. W. Carothers, and D. B. Wertheimer. 1974. The importance of the lower Gila River, New Mexico as a refuge for threatened wildlife. Xeroxed ms., prepared for U.S. Fish and Wildlife Service; 51 pp.

Koster, W. J. 1957. Guide to the fishes of New Mexico. Univ. New Mexico Press, Albuquerque.

LaBounty, J. F. and W. L. Minckley. 1972. Native fishes of the upper Gila River system, New Mexico, in Symposium on Rare and Endangered Wildlife, N.M. Dept. Game and Fish.

Ligon, J. S. 1961. New Mexico birds and where to find them. Univ. New Mexico Press, Albuquerque.

McClellan, J. 1954. An otter catch on the Gila River in southwestern New Mexico. J. Mammal. 35:443-444.

Ohmart, R. D. 1973. General discussion of the impact of the Central Arizona Project on the birds and mammals of the area. Xeroxed ms., 41 pp.

Raught, R. W. 1967. Tree squirrels in New Mexico Wildlife Management, N.M. Dept. Game and Fish, Santa Fe.

Zeller, H. M. 1968. Report on Hooker Dam. Xeroxed report of Sierra Club, Rio Grande Chapter; 17 pp.

Zimmerman, D. A. 1968. The Gila Valley in southwestern New Mexico as an important wildlife reservoir. Xeroxed ms., (report for Bureau of Outdoor Recreation?); 12 pp.

Zimmerman, D. A. 1970. Birds and bird habitats on national forest lands in the Gila River Valley, southwestern New Mexico, Xeroxed ms., prepared for U.S. Forest Service; 44 pp.

APPENDIX A

MEMORANDUM OF UNDERSTANDING FOR INTERAGENCY COOPERATION TO MAKE INVENTORIES IDENTIFY LAND USE PRACTICES, AND MAKE RECOMMENDATIONS FOR MANAGEMENT OF THE LOWER GILA RIVER IN NEW MEXICO[1]

This Memorandum of Understanding made and entered into between (1) New Mexico Department of Game and Fish; (2) Southwestern Region, Forest Service, United States Department of Agriculture; and (3) the Soil Conservation Service, United States Department of Agriculture; and (4) Bureau of Reclamation, United States Department of Interior; and (5) Bureau of Land Management, United States Department of the Interior and (6) Bureau of Sport Fisheries and Wildlife, United States Department of the Interior; witnesseth that:

WHEREAS, the Federal Agencies have been instructed by the Congress of the United States to protect and enhance wildlife habitat for rare and endangered species as stated in the "Endangered Species Preservation Act" of October 15, 1966 (80 Stat. 926; 16 U.S.C. 668aa(c)), and

WHEREAS, the New Mexico Department of Game and Fish is responsible for the management and protection of wildlife species within the state, and

WHEREAS, the parties hereto are mutually interested and desire to conduct inventories and investigate compatible land uses in order to formulate recommendations for a cooperative wildlife management program to protect and enhance the wildlife species and wildlife habitat of the riparian and aquatic biomes in that portion of the Gila River Valley in New Mexico below the Gila Wilderness boundary, and

WHEREAS, to meet the above stated interests of this agreement by June 30, 1974, wildlife species including fish, amphibians, reptiles, birds, and mammals, their habitat, and existing land use practices must be identified and described:

NOW THEREFORE, the parties hereto desire and agree to cooperate as follows:

[1]This copy has been typed from the signed original in order to reduce the number of pages and thereby save space.

A. That the New Mexico Department of Game and Fish will:
   1. Provide the leadership in conducting inventories of wildlife species.
   2. Type - map vegetation and identify rare and endangered plant communities on lands owned by the Department of Game and Fish.
   3. Assist in identifying land use practices which may affect future management of the area.
   4. Assist in locating permanent sample sites for aquatic habitat studies and in sampling fish populations, to determine species composition and relative populations,
   5. Assist in determining limiting factors to aquatic and terrestrial wildlife species.
   6. Make recommendations as to areas on which habitat development could be undertaken to improve or protect aquatic and terrestrial wildlife populations.
   7. Prepare a management plan to protect rare and endangered wildlife on lands owned by the Department of Game and Fish.

B. That the U.S. Forest Service (Gila National Forest) Will, On Lands Administered By Them:
   1. Prepare maps, overlays and aerial photographs.
   2. Type - map vegetation and identify rare and endangered plant communities.
   3. Assist the New Mexico Department of Game and Fish in the inventory of wildlife species.
   4. Assist in identifying land use practices which may affect future management of the area.
   5. Assist in determining the limiting factors to aquatic and terrestrial wildlife species.
   6. Prepare a management plan to protect rare and endangered wildlife.

C. That the Soil Conservation Service Will, On Private Lands Adjacent to the Gila River:
   1. Prepare maps, overlays and aerial photographs.
   2. Type - map vegetation and identify rare and endangered plant communities.
   3. Assist the New Mexico Department of Game and Fish in the inventory of wildlife.
   4. Assist in identifying land use practices which may affect future management of the area.
   5. Assist in determining the limiting factors to aquatic and terrestrial wildlife habitat.
   6. Make recommendations as to areas on which habitat development could be undertaken to improve or protect

aquatic and terrestrial wildlife populations.

D. That the Bureau of Reclamation Will:
   1. Keep the other agencies informed as to the current status of all proposed, planned, and approved developments on the Gila River in New Mexico.
   2. Provide such information as they may have available relating to wildlife species or habitat in the area.
   3. Assist in identifying land use practices which may affect future management of the area.

E. That the Bureau of Land Management Will, on Land Administered By Them:
   1. Prepare maps, overlays and aerial photographs.
   2. Type - map vegetation and identify rare and endangered plant communities.
   3. Assist the New Mexico Department of Game and Fish in the inventory of wildlife species.
   4. Assist in identifying land use practices which may influence future management of the area.
   5. Assit in determining the limiting factors to aquatic and terrestrial wildlife species.
   6. Prepare a management plan to protect rare and endangered wildlife.

F. That the Bureau of Sport Fisheries and Wildlife Will:
   1. Act as coordinator in pursuing the objectives of this Memorandum of Understanding.
   2. Provide technical assistance, including literature reviews, to the other agencies.
   3. Assist the New Mexico Department of Game and Fish in the inventory of wildlife species.
   4. Assist in identifying land use practices which may affect future management of the area.
   5. Assist in determining the limiting factors to aquatic and terrestrial wildlife species.
   6. Make recommendations as to areas on which habitat development could be undertaken to improve or protect aquatic and terrestrial populations.
   7. Prepare in consultation with all parties to this Memorandum of Understanding basic objectives and recommendations to protect rare and endangered wildlife along the Lower Gila River in New Mexico and submit same to the Director, New Mexico Department of Game and Fish and Secretaries of Agriculture and Interior.

G. It is Mutually Agreed That:

1. The coordinating agency will call meetings of representatives from each agency when deemed necessary by the parties to this agreement.
2. A training session will be called by the coordinating agency during the first week of March, 1973, for those involved in the inventory work to establish standardized inventory techniques.
3. Any party to this agreement may withdraw therefrom upon notice in writing to the other parties.
4. That nothing in this Agreement shall be construed as obligating the cooperating parties to expend or involve the United States or the State of New Mexico in any contract or other obligations for future payment of money in excess of appropriations authorized by law and administratively made available for this project.

IN WITNESS WHEREOF, the parties hereto have executed this Memorandum of Understanding to become effective upon the date subscribed by the last signature:

Date: January 17, 1973
Ladd S. Gordon
Director, New Mexico Department of Game and Fish

Date: January 18, 1973
for T. W. Koskella
Regional Forester, Southwestern Region, Forest Service, USDA

Date: January 24, 1973
M. E. Strong
State Conservationist
Soil Conservation Service

Date: January 26, 1973
W. O. Nelson, Jr.
Regional Director
Bureau of Sport Fisheries and Wildlife

Date: January 17, 1973
W. J. Anderson
State Director, New Mexico
Bureau of Land Management

Date: February 7, 1973
E. A. Lundberg
Regional Director
Bureau of Reclamation

APPENDIX B

WATER QUALITY OF THE LOWER GILA RIVER, NEW MEXICO[1]

Station	Gila R. at Turkey Cr.	Middle Box at Telegraph Hill	Red Rock Bridge
Water Temperature (°F)	52	62	65
Air Temperature (°F)	59	78	77
Dissolved Oxygen (mg/l.)	13	19	12
CO_2 (mg/l.)	4	4	7
Transmittance	100		
pH	7.7	7.6	7.5
TDS	236	247	307
Na	32.4	37.0	40.9
K	2.3	3.1	3.5
Ca	28.5	35.5	49.1
mg	5.1	6.9	8.3
HCO_3	123	167	212
Cl	24.5	15.6	20.9
SO_4	33.6	40.8	45.6
NO_3	-	-	-
B	*.1	*.1	*.1
F	2.67	2.06	2.10
SiO_2	43	36	35
PO_4	*1.0	*1.0	*1.0
Ag	*.004	*.004	*.004
Ba	*.1	.2	*.1
Be	*.005	*.005	*.005
Bi	*.1	*.1	*.1
Cd	*.002	*.002	*.002
Cr	*.04	*.04	*.04
Cs	*.04	*.04	*.04
Cu	*.004	*.004	*.004
Fe	*.02	*.02	*.02
Li	.06	.06	.07
Mn	*.01	*.01	*.01
Ni	*.02	*.02	*.02
Pb	*.02	*.02	*.02
Rb	*.02	*.02	*.02
Sb	*.2	*.2	*.2
Se	*1.0	*1.0	*1.0
Sn	*.2	*.2	*.2
Sr	.06	.08	.13
Zn	.07	.02	.02

[1]Done by Bureau of Reclamation, Regional Soil and Water Laboratory, and by Desert Research Institute, Boulder City, Nev. Elements and compounds in parts/million * indicates values are less than figures shown; samples taken October 1973.

APPENDIX C

FLORA OF THE LOWER GILA VALLEY AND VICINITY, NEW MEXICO

POLYPODIACEAE (Ferns)[1]
- *Pellaea atropurpurea*

PINACEAE (Pines)
- *Pinus edulis* (pinyon)
- *P. cembroides*

CUPRESSACEAE (Junipers)
- *Juniperus monosperma* (one-seeded juniper)
- *J. deppeana*

EPHEDRACEAE (Ephedras)
- *Ephedra trifurca*

TYPHACEAE (cattails)
- *Typha latifolia*

GRAMINEAE (Grasses)
- *Bromus ciliatus*
- *B. marginatus*
- *B. catharticus*
- *B. secalinus*
- *B. frondosus*
- *Poa fendleri*
- *Eragrostis pilosa*
- *E. cilianensis*
- *E. intermedia*
- *Agropyron smithii*
- *Elymus canadensis*
- *Sitanion hystrix*
- *Hordeum caespitosum*
- *H. leporinum*
- *Polypogon monspeliensis*
- *Muhlenbergia torreyi*
- *M. racemosa*
- *M. repens*
- *M. rigida*
- *M. dubia*
- *M. monticola*
- *M. rigens*
- *M. sinuosa*
- *M. asperifolia*
- *Sporobolus airoides*
- *S. wrightii*
- *Blepharoneuron tricholepis*
- *Tridens pulchellus*
- *Stipa emineus*
- *Hilaria berlangeri*
- *Tragus berteronianus*
- *Aristida adscencionis*
- *A. glauea*
- *Leptochloa dubia*
- *Cynodon dactylon* (Bermuda grass)
- *Bouteloua radicosa*
- *B. barbata*
- *Paspalum sanguinalis*
- *Trichachne californica*
- *Panicum hirticuaule*
- *P. hallii*
- *P. plenum*
- *P. bulbosum*
- *Echinoclloa crusgalli*
- *Setaria grisebachii*
- *S. macrostachya*
- *Andropogon cirratus*
- *Sorghum halepense*

CYPERACEAE (Sedges)
- *Cyperus fendlerianus*
- *C. odoratus*
- *Scirpus californicus*
- *S. acutus*
- *Carex occidentalis*
- *C. agrostoides*
- *Eleocharis montana*

LILIACEAE (Lilies, etc.)
- *Dichelostemma pulchellum*
- *Yucca baccata*

[1]Common names are given for families and selected species only.

Y. elata
Nolina microcarpa
Dasylirion wheeleri

AMARYLLIDACEAE (Agaves, etc.)
Agave palmeri

ORCHIDACEAE (Orchids)
Epipactis gigantea

SAURURACEAE (Lizardtails)
Anemopsis californica

SALICACEAE (Cottonwoods, etc.)
Populus fremontii (Fremont Cottonwood)
P. angustifolia (narrowleaf cottonwood)
Salix irrorata
S. exigua
S. amygdaloides
S. gooddingii (Goodding willow)

JUGLANDACEAE (Walnuts)
Juglans major (Arizona walnut)

ULMACEAE (elms)
Ulmus pumilus (Chinese elm)

BETULACEAE (Alders, etc.)
Alnus oblongifolia (Arizona alder)

FAGACEAE (oaks)
Quercus emoryi (Emory oak)
Q. grisea (gray oak)
Q. turbinella

MORACEAE
Morus microphylla (Texas mulberry)
Maclura pomifera (Osage orange)
Celtis reticulata (netleaf hackberry)

URTICACEAE (Nettles)
Urtica gracilenta

LORANTHACEAE (Mistletoes)
Phoradendron coryae
P. flavescens
P. bolleanum

POLYGONACEAE
(Buckwheats, etc.)
Eriogonum albertianum
E. polycladon
E. wrightii
Rumex hymenosepalus
R. altissimus
R. fueginus
Polygonum aviculare
P. ramosissimum

CHENOPODIACEAE
(Goosefoots, etc.)
Chenopodium watsoni
C. album
C. leptophyllum
Atriplex wrightii
Salsola kali

AMARANTHACEAE
(Amaranths, etc.)
Amaranthus torreyi
Brayulina densa
Froelichia gracilis

NYCTAGINACEAE
Allionia choisyi
A. linearifolia
Mirabilis linearis
Boerhavia coccinea
B. intermedia
B. erecta

AIZOACEAE (Carpetweed)
Mollugo verticillata

PORTULACACEAE (Portulacas)
Portula suffrutescens
Talinum spp.

CERATOPHYLLACEAE
(Hornworts)
Ceratophyllum demersum

RANUNCULACEAE (Buttercups)
Ranunculus scleratus

PAPAVERACEAE (Poppies)
- Argemone platyceras
- Escholzia parvula
- Corydalis aurea

CRUCIFERAE (Mustards)
- Lepidium medium
- Halimolobus diffusus
- Rorippa hispida
- R. nasturtium-aquaticum (watercress)
- Lesquerella gordoni
- Draba cuneifolia
- D. mogollonica
- Arabis angulata

CAPRARIDACEAE (Capers)
- Cleome serrulata
- Polanisia uniglandulosa

SAXIFRAGACEAE (Saxifrages, etc.)
- Fendlera rupicola
- Ribes aureum

PLANTANACEAE (Sycamores)
- Plantanus wrightii (Arizona scyamore)

ROSACEAE (Roses, etc.)
- Rosa fendleri
- Amelanchier utahensis
- Fallugia paradoxa (Apache plume)
- Cercocarpus montanus (Mountain mahogany)

LEGUMINOSAE (Beans, etc.)
- Acacia angustissima (catclaw)
- A. greggii (catclaw)
- A. constricta (whitethorn)
- Prosopis juliflora (mesquite)
- Krameria lanceolata
- Cassia bauhinoides
- Hoffmanseggia drepanocarpa
- Sophora sericea
- Lupinus concinnus
- Melilotus albus
- Medicago sativa
- Lotus humistratus
- L. rigidus
- L. greenei
- Amorpha fruticoa (false-indigo)
- Dalea calycosa
- D. formosa
- D. pogonothera
- D. grayi
- D. albiflora
- D. jamesii
- Astragalus nuttallianus
- A. brandegei
- A. allochrous
- A. humistriatus
- Hedysarum onobrychus
- Caesalpinia gillsii
- Robinia pseudacacia (black locust)
- Desmodium neomexicanum
- D. grahami
- Vicia exigua
- Galactia wrightii
- Phaseolus acutifolius
- P. metcalfei
- P. angustissimus
- P. grayanus
- Gleditsia triacanthos

LINACEAE (Flaxes)
- Linum vestitum (puberula?)

OXALIDACEAE (Wood-sorrels)
- Oxalis albicans

ZYGOPHYLLACEAE (Caltrops)
- Tribulus terrestris
- Kallstroemia grandiflora
- K. californica
- Larrea tridentata (creosotebush)

KOEBERLINACEAE (Allthorns)
- Koeberlinia spinosa (allthorn)

RUTACEAE (Rues)
- Ptelea angustifolia (hoptree)
- Thamnosma texana

SIMAROUBACEAE (Simaroubas)
Ailanthus altissima (tree-of-heaven)

POLYGALACEAE (Milkworts)
Polygala obscura
Monnina wrightii

EUPHORBIACEAE (Spurges)
Euphorbia maculata
E. albomarginata
Croton texensis
Acalypha neomexicana
A. lindheimeri

ANACARDIACEAE (Sumacs)
Rhus radicans
R. microphylla
R. trilobata (skunkbush sumac)

ACERACEAE (Maples)
Acer negundo (boxelder)

SAPINDACEAE (Soapberries)
Sapindus drummondii (Western soapberry)

RHAMNACEAE (Buckthorns)
Condalia lycioides
Rhamnus californica (California buckthorn)

VITACEAE (Grapes)
Vitis arizonica (Arizona grape)

MALVACEAE (Mallows)
Abutilon parvulum
Sphaeralcea subhastata
S. fendleri
S. angustifolia
S. coccinea
Malva neglecta
Sida lepidota
Anoda cristata

TAMARICACEAE (Tamarisks)
Tamarix chinensis (salt-cedar)

VIOLACEAE (Violets)
Hypanthus verticillata

LOASACEAE (Loasas)
Mentzelia albicaulis

CACTACEAE (Cacti)
Echinocereus fendleri
Mamillaria wrightii
M. viridiflora
M. triglochidiatus
M. gummifera
M. grahami
Coryphantha scheeri
Opuntia standlyi
O. spinosior (cholla)
O. chlorotica (prickly pear)
O. macrocentra (prickly pear)
O. phaeacantha (prickly pear)
O. engelmannii (prickly pear)

ONAGRACEAE (Evening-primroses)
Oenothera albicaulis
Guara spp.

CORNACEAE (Dogwoods,etc.)
Garrya wrightii

UMBELLIFERAE (Carrots,etc.)
Cymopterus multinervatus
Pseudocymopterus montanus
Lomatium oriental

FOUQUIERACEAE (Ocotillos)
Fouquieria splendens

OLEACEAE (Ashes, etc.)
Menodora scabra
Forestiera neomexicana
Eleganus angustifolia
Fraxinus anomala
F. velutina (velvet ash)

APOCYNACEAE (Dogbanes)
Apocynum suksdorfii
Amsonia longiflora

ASCLEPIADACEAE (Milkweeds)
Asclepias macrotis
A. latifolia
A. emoryi

CONVOLVULACEAE (Morninglories)
Evolvulus sericeus
Ipomoea costellata
I. hirsutula
Convolvulus arvensis
C. incanus
Cuscuta umbellata

POLEMONIACEAE (Phloxes)
Gilia brachysiphon
G. sinuata
G. aurea

HYDROPHYLLACEAE (Waterleafs)
Nama hispidum
Phacelia alba
P. arizonica
P. bombycina

BORAGINACEAE (Borages)
Lappula redowski
Lithospermum incisum
Cryptantha crassisepala
C. jamesii

VERBENACEAE (Verbenas)
Verbena wrightii
Aloysia wrightii
Tetraclea coulteri

LABIATAE (Mints)
Agastache wrightii
A. rupestris
Stachys coccinea
Salvia pinguifolia
Hedeoma latum
Lycopus americanus
Mentha arvensis

SOLANACEAE (Nightshades)
Lycium pallidum
Margaranthus solanaceus
Physalis pubescens
P. fendleri
P. hederaefolia
Solanum jamesii
S. nigrum
S. eleagnifolium
S. heterodontus
Datura meteloides
D. quercifolia
Nicotiana attenuata
N. trigonophylla

SCROPHULARIACEAE
(Figworth, etc.)
Verbascum thapsus
Penstemon barbatus
P. lanceolatus
P. linarioides
P. pseudospectabilis
Mimulus glabratus
M. cardinalis
Castilleia spp.

ACANTHACEAE (Acanthuses)
Anisacanthus thurberi

BIGNONOACEAE (Catalpas)
Chilopsis linearis
(desert-willow)
Caltapa sp. (catalpa)

MARTYNIACEAE (Devils-horns)
Proboscidae parviflora

PLANTAGINACEA (Plantains)
Plantago purshii

RUBIACEAE (Bedstraws,etc.)
Galium rothrockii
G. fendleri

CAPRIFOLIACEA
(Honysuckles, etc.)
Sambucus mexicana
(Mexican elder)

CUCURBITACEAE (Gourds)
Marah gilensis
Sicyos ampelophyllus
Apodanthera undulata
Cucurbita digitata
C. foestidissima

COMPOSITAE (Composites)
Eupatorium pauperculum
Brickellia grandiflora
B. brachyphylla
B. venosa
B. chenopodina
B. californica
Kuhnia rosmarinifolia
Gutierrezia sarothrae
G. microcephala
Aplopappus gracilis
Chrysothamnus nauseosus
Aster ericoides
A. wootonii
A. spinosus
A. riparius
A. tephrodes
A. aquifolius
Erigeron "arenarius"
E. neomexicanus
Conyza coulteri
Baccharis pteronoides
B. glutinosa (seepwillow)
B. sarothroides
Gnaphalium chilense
Melampodium leucanthum
Berlandiera lyrata
Parthenium incanum
Iva ambrosaefolia
Hymenoclea monogyra (burrobrush)
Ambrosia aptera
A. artemesifolia
Xanthium saccharatum
Zaluzania annua
Viguiera cordifolia
Helianthus annuus
H. petiolaris
H. tuberosus
Bidens bigelovii
Verbesina encelioides
Layia glandulosa
Psilostrophe cooperi
P. tagetina
Baileya radiata
Baeria chrysostoma
Chaenactis stevioides
Hymenothrix wislizeni
Selloa glutinosa
Hymenoxys odorata
Dyssodia papposa
Pectis prostrata
P. filipes
Artemisia ludoviciana
A. tridentata
Senecio longilobus
Cirsium neomexicanum
C. megacephalum
C. ochrocentrum
Centaurea americana
Perezia nana
P. wrightii
Trixis californica
Stephanomeria thurberi
Rafinesquia neomexicana
Sonchis asper
Lactuca pulchella
Pyrrhopappus multicaulis
Grindelia sp.

APPENDIX D

RIPARIAN CONDITION TRANSECT FORM[1]

(Front)

USDA Forest Service

RIPARIAN CONDITION TRANSECT

Ref. FSH 2620

Transect Identification No. _____ Aerial Photo No. _____ Date _____

Type Designation _____

Land Status _____ Examiners _____

Transect Location _____

TALLY BLOCK

CONDITION RATING FROM SCORECARD

Composition	Density	Vigor	Stand Structure	Soil

H = High M = Medium L = Low

ITEM	HITS	TALLY	TOTAL
Bare Gr. & EP			
Rock			
Litter			
G&F SPP.			

	DENSITY		
	Basil Area	Crown Density	Total
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
Tot.			
Ave.			

1. Bare ground and erosion pavement. _____
2. Rock _____
3. Grasses & Forbs _____
4. Litter _____

Ground cover index (Sum of Items 2, 3, & 4.) _____

COMPOSITION BY SIZE CLASS (RIPARIAN)

SPECIES	Sprout	Sapling	Pole	Mature	Dead	%	SPROUTS ONLY Browsed	SPROUTS ONLY Unbrowsed
Total %								

PELLET GROUP COUNTS

Plot No.	1	2	3	4	5	6	7	8	9	10	Total	Per Acre
Wildlife												
Livestock												

R 3-2600-27 (Rev. 9/75)

[1]Form used in 1973 differed slightly from that shown here (size of form originally 8 x 10½ inches).

(Back)

PACED RANGE TRANSECT – RIPARIAN TYPE

COMPOSITION

SPECIES	HITS	TALLY	TOTAL
Dec.			
Inc.			
Inv.			
Litter			
Rock			
Bare Ground			

PLOT TALLY

CONDITION AND TREND RATING

from Scorecard _____ Dated _____

Vegetation		Soil Stability	
Forage Cover Index		Erosion Hazard	
Composition		Current Erosion	
Vigor			
Total		Total	
Condition Class		Condition Class	
Current Trend		Current Trend	

CONDITION AND TREND RATING

SUMMARY OF HITS

Hits, all plants _____

Rock _____

Litter _____

Bare Soil _____

Total _____

Hits, Forage Plants _____

Erosion Hazard Index _____

VIGOR

SPECIES

Plant	Leaf Ht.	Leaf Ht.
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
ave		

COMPOSITION SUMMARY

	Hits	Comp %	Allow Comp/	Comp/ Value
DECREASERS				(X2)
INCREASERS				(X¼)
INVADERS				(X-1)
TOTAL				

TYPING DESIGNATION

Transect No., Vegetation Type, predominant vegetation, vegetation and soil score and trend.

APPENDIX E

MAMMALS OF THE LOWER GILA VALLEY, NEW MEXICO

Desert shrew - Notiosorex crawfordi
Cave myotis - Myotis velifer
Small-footed myotis - Myotis leibii
Fringed myotis - Myotis thysanodes
Keen's myotis - Myotis auriculus
Silver-haired bat - Lasionycteris noctivagans
Big brown bat - Eptesicus fuscus
Hoary bat - Lasiurus cinereus
Red bat - Lasiurus borealis
Western big-eared bat - Plecotus townsendii
Pallid bat - Antrozous pallidus
Western pipistrelle - Pipistrellus hesperus
Mexican freetail bat - Tadarida brasiliensis
Grizzly bear - Ursus arctos (extirpated)
Black bear - Ursus americanus
Raccoon - Procyon lotor
Coatimundi - Nasua narica
Ring-tailed cat - Bassariscus astutus
Badger - Taxidea taxus
River otter - Lontra candensis (State endangered)
Spotted skunk - Spilogale putorius
Striped skunk - Mephitis mephitis
Hooded skunk - Mephitis macroura
Hog-nosed skunk - Conepatus leuconotus
Gray wolf - Canis lupus (extirpated)
Coyote - Canis latrans
Kit fox - Vulpes macrotis
Gray fox - Urocyon cinereoargenteus
Mountain lion - Felis concolor
Bobcat - Lynx rufus
Rock squirrel - Spermophilus variegatus
Spotted ground squirrel - Spermophilus spilosoma
Harris' antelope squirrel - Spermophilus harrisi
Black-tailed prairie dog - Cynomys ludovicianus (extirpated-
Cliff chipmunk - Eutamias dorsalis State endangered)
Arizona gray squirrel - Sciurus arizonensis
Valley pocket gopher - Thomomys bottae
Silky pocket mouse - Perognathus flavus
Desert pocket mouse - Perognathus penicillatus
Rock pocket mouse - Perognathus intermedius
Hispid pocket mouse - Perognathus hispidus
Merriam kangaroo rat - Dipodomys merriami
Ord's kangaroo rat - Dipodomys ordi

Bannertail kangaroo rat - Dipodomys spectabilis
Western harvest mouse - Reithrodontomys megalotis
Deer mouse - Peromyscus maniculatus
Cactus mouse - Peromyscus eremicus
White-footed mouse - Peromyscus leucopus
Brush mouse - Peromyscus boylii
Southern grasshopper mouse - Onychomys torridus
Northern grasshopper mouse - Onychomys leucogaster
Hispid cotton rat - Sigmodon hispidus
Least cotton rat - Sigmodon fulviventer
White-throated woodrat - Neotoma albigula
Desert woodrat - Neotoma lepida
Muskrat - Ondatra zibethica
House mouse - Mus musculus (introduced)
Porcupine - Erethizon dorsatum
Beaver - Castor canadensis
Mule deer - Odocoileus hemionus
White-tailed - Odocoileus virginianus
Bighorn sheep - Ovis canadensis
Collared peccary - Dicotyles tajacu
Pronghorn antelope - Antilocapra americana
Black-tailed jackrabbit - Lepus californicus
Desert cottontail - Sylvilagus auduboni

APPENDIX F

BIRDS OF THE LOWER GILA VALLEY, NEW MEXICO[1]

Horned grebe - Podiceps auritus
Eared grebe - Podiceps caspicus
Western grebe - Aechmophorus occidentalis
*Pied-billed grebe - Podilymbus podiceps
Double crested cormorant - Phalacrocorax auritus
Olivaceous cormorant - Phalacrocorax olivaceus (State endangered)
*Great blue heron - Ardea herodias
*Green heron - Butorides virescens
Common egret - Casmerodius albus
Snowy egret - Egretta thula
*Black-crowned night heron - Nycticorax nycticorax
Yellow-crowned night heron - Nyctanassa violacea
Least bittern - Ixobrychus exilis
White-faced ibis - Plegadis chihi
Whistling swan - Olor columbianus
Canada goose - Branta canadensis
Snow goose - Chen caerulescens
Black-bellied tree duck - Dendrocygna autumnalis
*Mallard - Anas platyrhynchos
*Mexican duck - Anas diazi (Federal endangered)
Gadwall - Anas strepera
Pintail - Anas acuta
Green-winged teal - Anas crecca
*Blue-winged teal - Anas discors
*Cinnamon teal - Anas cyanoptera
American widgeon - Anas americana
Northern shoveler - Spatula clypeata
Wood duck - Aix sponsa
Redhead - Aythya americana
Ring-necked duck - Aythya collaris
Canvasback - Aythya valisineria
Lesser scaup - Aythya affinis
Bufflehead - Bucephala albeola
Common goldeneye - Bucephala clangula
Surf scoter - Melanitta perspicillata
White-winged scoter - Melanitta deglandi
Ruddy duck - Oxyura jamaicensis
*Common merganser - Mergus merganser
Red-breasted merganser - Mergus serrator
*Turkey vulture - Cathartes aura

[1]Asterisk indicates breeding species of the valley.

Mississippi kite - Ictina misisippensis (State endangered)
Goshawk - Accipiter gentilis
*Sharp-shinned hawk - Accipiter striatus
*Cooper's hawk - Accipiter cooperii
*Red-tailed hawk - Buteo jamaicensis
*Swainson hawk - Buteo swainsoni
*Zone-tailed hawk - Buteo albonotatus (State endangered)
Ferruginous hawk - Buteo regalis
Broad-winged hawk - Buteo platypterus
*Gray hawk - Buteo nitidus (State endangered)
*Black hawk - Buteogallus anthracinus (State endangered)
*Golden eagle - Aquila chrysaetos
Bald eagle - Haliaeetus leucocephalus (Federal endangered)
Marsh hawk - Circus cyaneus
Osprey - Pandion haliaetus (State endangered)
*Prairie falcon - Falco mexicanus
Peregrine falcon - Falco peregrinus (Federal endangered)
Merlin - Falco columbarius
*American kestrel - Falco sparverius
*Scaled quail - Callipepla squamata
*Gambel's quail - Lophortyx gambelii
*Montezuma quail - Cyrtonyx montezumae
*Ring-necked pheasant - Phasianus colchicus (Introduced)
Turkey - Meleagris gallopavo
Sandhill crane - Grus canadensis
*Sora - Porzana carolina
*Common gallinule - Gallinula chloropus
*American coot - Fulica americana
*Killdeer - Charadrius vociferus
Common snipe - Capella gallinago
*Spotted sandpiper - Actitis macularia
Solitary sandpiper - Tringa solitaria
Greater yellowlegs - Tringa melanoleucus
Lesser yellowlegs - Tringa flavipes
Willet - Catoptrophorus semipalmatus
Pectoral sandpiper - Calidris melanotos
Least sandpiper - Calidris minutilla
Long-billed dowitcher - Limnodromus scolopaceus
Wilson's phalarope - Steganopus tricolor
Northern phalarope - Lobipes lobatus
Herring gull - Larus argentatus
Ring-billed gull - Larus delawarensis
*Band-tailed pigeon - Columba fasciata
*White-winged dove - Zenaida asiatica
*Mourning dove - Zenaida macroura
Ground dove - Columbina passerina
*Inca dove - Scardafella inca

*Yellow-billed cuckoo - Coccyzus americanus
*Roadrunner - Geococcyx californianus
*Barn owl - Tyto alba
*Screech owl - Otus asio
Flammulated owl - Otus flammeolus
*Great horned owl - Bubo virginianus
*Elf owl - Micrathene whitneyi
Pygmy owl - Glaucidium gnoma
Long-eared owl - Asio otus
Whip-poor-will - Caprimulgus vociferus
*Poorwill - Phalaenoptilus nuttallii
*Common nighthawk - Chordeiles minor
*Lesser nighthawk - Chordeiles acutipennis
Black swift - Cypseloides niger
*White-throated swift - Aeronautes saxatalis
*Black-chinned hummingbird - Archilochus alexandri
*Costa's hummingbird - Calypte costae
Broad-tailed hummingbird - Selasphorus platycercus
Rufous hummingbird - Selasphorus rufus
Calliope hummingbird - Stellula calliope
Rivoli hummingbird - Eugenes fulgens
Belted kingfisher - Megaceryle alcyon
*Northern flicker - Colaptes auratus
*Gila woodpecker - Centurus uropygialis (State endangered)
*Acorn woodpecker - Melanerpes formicivorus
Lewis' woodpecker - Asyndesmus lewis
Yellow-bellied sapsucker - Sphyrapicus varius
Williamson's sapsucker - Sphyrapicus thyroideus
*Hairy woodpecker - Dendrocopos villosus
Downy woodpecker - Dendrocopos pubescens
*Ladder-backed woodpecker - Dendrocopos scalaris
*Western kingbird - Tyrannus verticalis
*Cassin's kingbird - Tyrannus vociferans
Scissor-tailed flycatcher - Muscivora forficata
*Wied's crested flycatcher - Myiarchus tyrannulus
*Ash-throated flycatcher - Myiarchus cinerascens
Eastern phoebe - Sayornis phoebe
*Black phoebe - Sayornis nigricans
*Say's phoebe - Sayornis saya
*Traill's flycatcher - Empidonax traillii
Hammond's flycatcher - Empidonax hammondii
Dusky flycatcher - Empidonax oberholseri
Gray flycatcher - Empidonax wrightii
Western flycatcher - Empidonax difficilis
Coues' flycatcher - Contopus pertinax
*Western wood pewee - Contopus sordidulus
Olive-sided flycatcher - Nuttallornis borealis

*Vermilion flycatcher - Pyrocephalus rubinus
*Horned lark - Eremophila alpestris
*Violet-green swallow - Tachycineta thalassina
*Tree swallow - Iridoprocne bicolor
Bank swallow - Riparia riparia
*Rough-winged swallow - Stelgidopteryx ruficollis
*Barn swallow - Hirundo rustica
*Cliff swallow - Petrochelidon pyrrhonota
Purple martin - Progne subis
Steller's jay - Cyanocitta stelleri
*Scrub jay - Aphelocoma coerulescens
*Mexican jay - Aphelocoma ultramarina
*Common raven - Corvus corax
*White-necked raven - Corvus cryptoleucus
*Common crow - Corvus brachyrhynchos
Pinyon jay - Gymnorhinus cyanocephalus
Clark's nutcracker - Nucifraga columbiana
Mountain chickadee - Parus gambeli
*Plain titmouse - Parus inornatus
*Bridled titmouse - Parus wollweberi
*Verdin - Auriparus flaviceps
*Bushtit - Psaltriparus minimus
*White-breasted nunhatch - Sitta carolinensis
Red-breasted nuthatch - Sitta canadensis
Pygmy nuthatch - Sitta pygmaea
Brown creeper - Certhia familiaris
Dipper - Cinclus mexicanus
House wren - Troglodytes aedon
*Bewick's wren - Thryomanes bewickii
*Cactus wren - Campylorhynchus brunneicapillus
Long-billed marsh wren - Telmatodytes palustris
*Canyon wren - Catherpes mexicanus
*Rock wren - Salpinctes obsoletus
*Mockingbird - Mimus polyglottos
*Bendire's thrasher - Toxostoma bendirei
*Curve-billed thrasher - Toxostoma curvirostre
*Crissal thrasher - Toxostoma dorsale
Sage thrasher - Oreoscoptes montanus
*Robin - Turdus migratorius
Hermit thrush - Catharus guttatus
Swainson's thrush - Catharus ustulatus
Eastern bluebird - Sialia sialis
Western bluebird - Sialia mexicana
Mountain bluebird - Sialia currucoides
Townsend's solitaire - Myadestes townsendi
*Blue-gray gnatcatcher - Polioptila caerulea
Black-tailed gnatcatcher - Polioptila melanura

Golden-crowned kinglet - Regulus satrapa
Ruby-crowned kinglet - Regulus calendula
Water pipit - Anthus spinoletta
Cedar waxwing - Bombycilla cedrorum
*Phainopepla - Phainopepla nitens
* Loggerhead shrike - Lanius ludovicianus
*Starling - Sturnus vulgaris (Introduced)
Hutton's vireo - Vireo huttoni
*Bell's vireo - Vireo bellii (State endangered)
*Gray vireo - Vireo vicinior
*Solitary vireo - Vireo solitarius
Warbling vireo - Vireo gilvus
Black-and-white warbler - Mniotilta varia
Tennessee warbler - Vermivora peregrina
Orange-crowned warbler - Vermivora celata
Nashville warbler - Vermivora ruficapilla
Virginia's warbler - Vermivora virginiae
*Lucy's warbler - Vermivora luciae
*Yellow warbler - Dendroica petechia
Yellow-rumped warbler - Dendroica coronata
Black-throated gray warbler - Dendroica nigrescens
Townsend's warbler - Dendroica townsendi
Grace's warbler - Dendroica graciae
Cape May warbler - Dendroica tigrina
Northern waterthrush - Seiurus noveboracensis
MacGillivray's warbler - Oporornis tolmiei
*Yellowthroat - Geothylpis trichas
*Yellow-breasted chat - Icteria virens
Red-faced warbler - Cardellina rubrifrons
Wilson's warbler - Wilsonia pusilla
American redstart - Setophaga ruticilla
Painted redstart - Setophaga picta
*House sparrow - Passer domesticus (Introduced)
*Eastern meadowlark - Sturnella magna
*Western meadowlark - Sturnella neglecta
Yellow-headed blackbird - Xanthocephalus xanthocephalus
*Red-winged blackbird - Agelaius phoeniceus
Orchard oriole - Icterus spurius
*Hooded oriole - Icterus cucullatus
*Scott's oriole - Icterus parisorum
*Northern oriole - Icterus galbula
Brewer's blackbird - Euphagus cyanocephalus
*Great-tailed grackle - Cassidix mexicanus
*Brown-headed cowbird - Molothrus ater
*Bronzed cowbird - Tangavius aeneus
Western tanager - Piranga ludoviciana

*Hepatic tanager - Piranga flava
*Summer tanager - Piranga rubra
*Cardinal - Cardinalis cardinalis
Pyrrhuloxia - Cardinalis sinuatus
Rose-breasted grosbeak - Pheucticus ludovicianus
*Black-headed grosbeak - Pheucticus melanocephalus
*Blue grosbeak - Guiraca caerulea
*Indigo bunting - Passerina cyanea
Lazuli bunting - Passerina amoena
Evening grosbeak - Hesperiphona vespertina
Cassin's finch - Carpodacus cassinii
*House finch - Carpodacus mexicanus
Pine siskin - Spinus pinus
American goldfinch - Spinus tristis
*Lesser goldfinch - Spinus psaltria
Red crossbill - Loxia curvirostra
Green-tailed towhee - Chlorura chlorura
Rufous-sided towhee - Pipilo erythrophthalmus
*Brown towhee - Pipilo fuscus
*Abert's towhee - Pipilo aberti
Lark bunting - Calamospiza melanocorys
Savannah sparrow - Passerculus sandwichensis
Vesper sparrow - Pooecetes gramineus
*Lark sparrow - Chondestes grammacus
*Rufous-crowned sparrow - Aimophila ruficeps
*Black-throated sparrow - Amphispiza bilineata
Sage sparrow - Amphispiza bellii
Dark-eyed junco - Junco hyemalis
Gray-headed junco - Junco caniceps
Chipping sparrow - Spizella passerina
Brewer's sparrow - Spizella breweri
*Black-chinned sparrow - Spizella atrogularis
White-crowned sparrow - Zonotrichia leucophrys
White-throated sparrow - Zonotrichia albicollis
Fox sparrow - Passerella iliaca
Lincoln's sparrow - Melospiza lincolnii
Swamp's sparrow - Melospiza georgiana
Song sparrow - Melospiza melodia

APPENDIX G

AMPHIBIANS AND REPTILES OF THE LOWER GILA VALLEY, NEW MEXICO

Tiger salamander - *Ambystoma tigrinum*
Couch's spadefoot toad - *Scaphiopus couchi*
Western spadefoot toad - *S. hammondi*
Plains spadefoot toad - *S. bombifrons*
Woodhouse toad - *Bufo woodhousei*
Great Plains toad - *B. cognatus*
Southwestern toad - *B. microscaphus*
Red-spotted toad - *Bufo punctatus*
Canyon treefrog - *Hyla arenicolor*
Bullfrog - *Rana catesbeiana* (introduced)
Leopard frog - *R. pipiens*
Sonora mud turtle - *Kinosternon sonoriense*
Spiny softshell - *Trionyx spiniferus*
Banded gecko - *Coleonyx variegatus*
Lesser earless lizard - *Holbrookia maculata*
Greater earless lizard - *H. texana*
Zebra-tailed lizard - *Callisaurus draconoides*
Collared lizard - *Crotophyta collaris*
Cervice spiny lizard - *Sceloporus poinsetti*
Clark's spiny lizard - *S. clarki*
Eastern fence lizard - *S. undulatus*
Side-blotched lizard - *Uta stansburiana*
Tree lizard - *Urosaurus ornatus*
Short-horned lizard - *Phrynosoma douglassi*
Round-tailed horned lizard - *P. modestum*
Great Plains skink - *Eumeces obsoletus*
Chihuahua whiptail - *Cnemidophorus exsanguis*
Western whiptail - *C. tigris*
Arizona alligator lizard - *Gerrhonotus kingi*
Gila monster - *Heloderma suspectum* (State endangered)
Western blind snake - *Leptotyphlops humilis*
Western hognose snake - *Heterodon nasicus*
Coachwhip - *Masticophis flagellum*
Striped whipsnake - *M. taeniatus*
Western patch-nosed snake - *Salvadora hexalepis*
Glossy snake - *Arizona elegans*
Bull snake - *Pituophis melanoleucus*
Common kingsnake - *Lampropeltis getulus*
Sonora mountain kingsnake - *Lampropeltis pyromelana* (State — endangered)
Long-nosed snake - *Phinocheilus lecontei*
Terrestrial garter snake - *Thamnophis elegans*
Mexican garter snake - *T. eques*

Black-necked snake - T. crytopsis
Plains black-headed snake - Tantilla nigriceps
Western black-headed snake - Tantilla planiceps
Night snake - Hypsiglena torquata
Arizona coral snake - Micruroides euryxanthus (State endangered)
Western diamondback rattlesnake - Crotalus atrox
Black-tailed rattlesnake - Crotalus molossus
Western rattlesnake - C. viridis

APPENDIX H

FISHES OF THE LOWER GILA DRAINAGE, NEW MEXICO[1]

Native species
- Gila sucker (Catostomus insignis)
- Gila mountain sucker (Pantosteus clarki)
- loach minnow (Tiaroga cobitis) (State endangered)
- spike dace (Meda fulgida) (State endangered)
- longfin dace (Agosia chrysogaster)
- speckled dace (Rhinichthys osculus)
- roundtail chub (Gila robusta) (State endangered)

Introduced species (Years known to have been collected)[1]
- cutthroat trout (Salmo clarki) 1970
- rainbow trout (Salmo gairdneri) 1940-1973
- brown trout (Salmo trutta) 1940-1973
- brook trout (Salvelinus fontinalis) 1960
- Rio Grande sucker (Pantosteus plebius) 1970
- carp (Cyprinus carpio) 1940-1973
- red shiner (Notropis lutrensis) 1950
- flathead chub (Hybopsis gracilis) 1950
- fathead minnow (Pimephales promelas) 1950-1973
- stoneroller (Campostoma anomalum) 1950
- channel catfish (Ictalurus punctatus) 1940-1973
- black bullhead (Ameiurus melas) 1950-1973
- yellow bullhead (Ameiurus natalis) 1940-1973
- flathead catfish (Pylodictis olivaris) 1960-1973
- mosquitofish (Gambusia affinis) 1940-1973
- largemouth bass (Micropterus salmoides) 1950-1970
- smallmouth bass (Micropterus dolomieui) 1950-1973
- bluegill (Lepomis macrochirus) 1950-1970
- green sunfish (Lepomis cyanellus) 1950-1973

[1]Survey data for 1940, 1950, 1960, and 1970 from LaBounty and Minckley (1972); 1973 data are from the Interagency survey.